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A CLASSIFICATION OF FOREST HABITAT TYPES IN NORTHERN NEW MEXICO AND SOUTHERN COLORADO

A CLASSIFICATION OF FOREST HABITAT TYPES IN NORTHERN NEW MEXICO AND SOUTHERN COLORADO

by

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RESEARCH SUMMARY

Climax vegetation integrates all impinging environmental factors and is thus a useful indicator of biotic potential. Land areas capable of supporting similar plant associations at climax are classified as the same habitat type. Habitat type classifications are useful in delimiting logical units for management and providing a common system for communication among diverse investigators. This usefulness is a strong rationale for selecting the habitat type approach for land classification. Our objective was to identify and describe forest habitat types in the mountains of northern New Mexico and southern Colorado.

The final classification is based on 617 sample plots. A total of 6 climax series, 31 habitat types, and 15 phases of habitat types are defined. Keys and descriptions for each habitat type are provided. Soils and vegetation relationships, successional trends, management implications. tree productivity from site index, and relationships to other habitat type classifications in the Rocky Mountains are discussed.

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INTRODUCTION

Land areas capable of supporting similar plant associations at climax are classified as the same habitat type (Daubenmire 1968). Since natural vegetation integrates all impinging environmental factors a given habitat type encompasses a relatively narrow range of environmental variation (Daubenmire 1976). Habitat type classifications of forests have proven to be of high utility to land managers (Layser 1974). The main advantage of habitat type classifications is that they provide a permanent and ecologically based system of land stratification (Pfister et al. 1977)

Habitat types are based on "climax or near climax" environments; thus they assume stable or near stable vegetation, climate, soils, and landform. However, even areas that have a history of high utilization and instability can be identified as to "potential" habitat type by a close examination of existing plant associations and soils (Barnes et al. 1982) and by using prior studies of plant successional relationships of these plant associations (Ludwig et al. 1977; Grieve et al. 1979).

Forestlands are valuable public resources that provide for timber, livestock, wildlife, watershed, and recreation. Effective management of forest resources requires a thorough understanding of how different habitat types respond to different management practices. A given habitat type represents a relatively narrow range of biotic potential and thus management options.

The objective of this study was the identification and description of forest habitat types in the mountains of northern New Mexico and southern Colorado. To produce a classification of maximal usefulness, soils, landform, and vegetation were integrated in the identification of habitat types. Such a strategy allows for field identification of

habitat types even though some characteristics may be altered or destroyed (Driscoll 1964).

Specifically, this study:

1. Provides a habitat type classification of forestlands in northern New Mexico and southern Colorado, incorporating elements of vegetation, soils, and landform,
2. Describes the management implications and successional trends of each habitat type, and
3. Estimates forest productivity within each habitat type.

Forest habitat type classifications have been developed for 30 areas in the western United States (Pfister 1981). Although the coverage of these treatments is large, extensive areas lacking habitat type investigations remain. Previous to this study, little documentation of the forest vegetation of northern New Mexico and southern Colorado had taken place. Moir and Ludwig (1979) described mixed conifer and spruce-fir forests in northern New Mexico but did not sample the extensive ponderosa pine forests. Vegetation studies are generally lacking for the forests of southern Colorado. Those that have been performed involved limited sampling areas. Peet (1981) sampled the Spanish Peaks, Dix and Richards (1976) sampled Missionary Ridge in the San Juan Mountains, and Langenheim (1949) sampled in the vicinity of Crested Butte, Colorado (slightly north of our study area).

STUDY AREA

Physiography

The study area encompasses the forest habitats of northern New Mexico and southern Colorado. Specifically, the forests studied occur in the Spanish Peaks and Wet Mountains of Colorado, and the San Juan and Sangre de Cristo mountains of both Colorado and New Mexico (Figure 1). Forestlands included in this study are those that support any, or a combination, of the following coniferous tree species: Pinus aristata, Abies lasiocarpa, Picea engelmannii, Picea pungens, Abies concolor, Pseudotsuga menziesii, and Pinus ponderosa.

There is considerable disagreement among ecologists regarding the climax or seral status of Pinus contorta and Populus tremuloides in the Rocky Mountains (Hoffman and Alexander 1980). In support of the possibility of these species being climax, Moir (1969) recognized a P. contorta zone in the Colorado Front Range where Pseudotsuga menziesii, Abies lasiocarpa, or Picea engelmannii had not "invaded" in 65 to 100 years of pine dominance. Despain (1983) noted climax Pinus contorta communities in Wyoming. Similarly, Populus tremuloides was observed forming 150-year-old stands in northern Colorado (Hoffman and Alexander 1980) where succession towards Abies and Picea was not evident. Generally, replacement of Populus tremuloides requires about 65 years (Ives 1941). Stands dominated by either of these species were not sampled in this study. Future studies should consider the climax status of these two species; particularly Populus tremuloides, which is important throughout the study area. Pinus contorta occurs as a minor component of forests in the Sangre de Cristo Range in Colorado, and in the Spanish Peaks and Wet Mountains. Populus tremuloides stands were noted in the Mancos Ranger District of the San Juan National Forest that

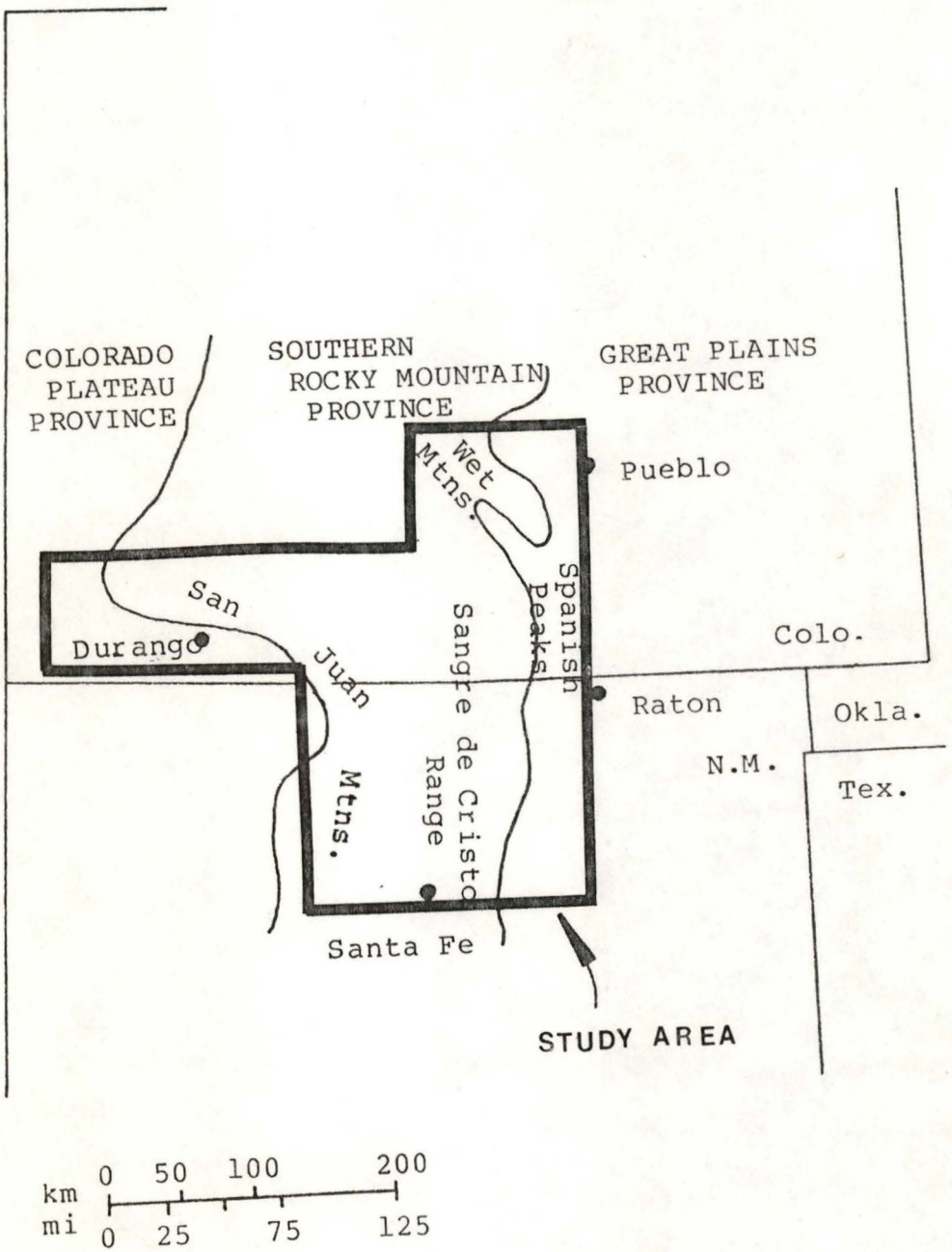

Figure 1. Physiographic features of the northern New Mexico- southern Colorado study area (after Thornbury 1965).

exhibited uneven-aged structure suggestive of self-replacement (climax).

Most of the data were collected within National Forests; however, a relatively small number of study plots were established on private and public lands outside National Forest boundaries. The sampling area ranged in elevation from about 1,800 m to 3,500 m and encompassed approximately four million hectares.

Physiographic provinces in the United States are defined in Thornbury (1965). Three provinces are represented in the study area (Figure 1) and may be described as follows:

Colorado Plateau Province

This province is bounded on the east by the San Juan Mountains uplift. Gently dipping sedimentary rocks characterize most of this province. Relief features are generally the result of incision of canyons into generally flat terrain, rather than upstanding mountain ranges. The Dakota Sandstone, Mesa Verde Sandstone, and Mancos Shale underlie much of the study area within the Colorado Plateau Province.

Forests studied in the province are predominantly Pinus ponderosa. Abies concolor is rare in this province and Pseudotsuga menziesii forests form a relatively minor topographic climax in some areas.

Southern Rocky Mountain Province

This province contains the major portion of the study area. Except for the San Juan Mountains in Colorado, the province is predominantly composed of north-south trending ranges of anticlinal structure having igneous and metamorphic rock cores flanked by sedimentary rocks. The ranges included in the portion of the Southern Rocky Mountain Province within the study area are the San Juan, Sangre de Cristo, and Wet mountains. Secondary ranges are recognized within the extensive San Juan Mountains. These include the La Plata, San Miguel, Needle, and

Rico mountains in Colorado, and the San Pedro, Jemez, and Sierra de Nacimiento mountains in New Mexico.

The San Juan Mountains were heavily glaciated during the Pleistocene. One late Wisconsin glacier, the Las Animas, was 65 kilometers long, making it perhaps the longest in the Rockies during Pleistocene times. The western flanks of the San Juan uplift is bounded by the La Plata, San Miguel, and Rico mountains.

A dramatic example of volcanic activity is the Valles Caldera in the Jemez Mountains of New Mexico. The caldera measures about 24 km in diameter and formed by collapse after extrusion of tremendous volumes of tuff.

The Sangre de Cristo Range extends from near Salida, Colorado to the vicinity of Santa Fe, New Mexico (a distance of about 225 km). Both the Sangre de Cristo and Wet mountains consist of a core of Precambrian schists, gneisses, pegmatites, and local bodies of granite and diorite with complexly folded sedimentary rocks occurring in some locations. Extensive Pleistocene glaciation occurred in these mountains.

The Southern Rocky Mountains are the highest in the Rocky Mountain System. Many peaks in excess of 4,250 m elevation occur within the province. Owing to the great environmental variation in the Southern Rocky Mountain Province, extensive examples of all forest series occur.

Great Plains Province

The Spanish Peaks of Colorado lie within this province. They represent two stocks of granite and granodiorite porphyry. Prominent features of the Spanish Peaks are dikes radiating from the stocks, much like the spokes of a wheel; some of these dikes are 40 km long.

Climate

Mountain climates of the western United States have been described by Baker (1944) and Bradley (1976). The average mountain temperature lapse rate is 0.6 degrees C per 100 m elevation increase. Generally, precipitation increases with elevation in the mountains. This correlation of precipitation and elevation is modified by three factors: approach effects, rain shadows, and canyon effects. The approach effect is a cooling effect as air masses are forced upward some distance to the windward of the mountains. This effect is more pronounced if steep, high, and massive mountains are involved. The cooling is basically the reason for increased precipitation with elevation. Rain shadows occur when air masses are dried by precipitation as they pass over mountains. Thus, the lee side of massive mountains particularly exhibit diminished precipitation with increased distance from the mountain crest. Canyon effects are instances where precipitation at a given elevation is heavier than expected due to the influence of major ridges surrounding a canyon.

Within the study area, an average of 40 percent of the annual precipitation falls during the period of June through August. The San Juan Mountains of Colorado are the coldest and wettest mountains in the study area. This is largely due to greater snow falls and the absence of chinook winds.

Annual precipitation at 2,000 m elevation is approximately 400 mm throughout the study area, however, annual precipitation at about 4,000 m ranges from approximately 1,000 mm in the San Juan Mountains in Colorado, to 900 mm in the mountains of northern New Mexico, and to 600 mm in the Sangre de Cristo Range, Wet Mountains, and Spanish Peaks of Colorado. The higher total precipitation at high elevation in northern

New Mexico relative to the mountains east of the Continental Divide in southern Colorado probably relates to the rain shadow effect of the massive San Juan Mountains in Colorado. Local conditions may produce precipitation much higher. For example, alpine rainforests in Colorado have been reported to receive in excess of 2,500 mm of precipitation during the summer (Ives 1942).

Snowfall accumulations vary from a maximum of 13 m in the San Juans of Colorado, to 8 m in the mountains of southcentral Colorado, and to 5 m in the mountains of northern New Mexico.

The number of frost-free days varies from less than 50 days in the Abies lasiocarpa series to over 120 days in the Pinus ponderosa series.

Daubenmire (1943) described vegetation zones in the Rocky Mountains. In hypothesizing causes of lower and upper altitudinal limits of species he contended that:

1) the upper limit is determined by temperature,
2) the lower limit is determined by drought, and
3) at intermediate elevations exposure and soils are significant in controlling species distribution patterns.

Daubenmire (1943) further proposed the upper timberline is primarily determined by desiccating winds. In southern Colorado, Bates (1924) observed that total wind for January averaged 21,000 km at upper timberline but was less than 9,700 km in the spruce-fir zone just below.

METHODS

Field Sampling

A habitat type classification is based on the potential climax vegetation for a given site (Daubenmire 1968). Hence, the confounding nature of successional vegetation on disturbed sites can be minimized by eliminating such sites from the data base used in the classification. We carefully selected plots for sampling within stands of climax or near climax vegetation following the guidelines of Moir and Ludwig (1983). Areas severely overgrazed, recently logged, brush control treated, artificially seeded or irrigated were not sampled.

Random or systematic sampling techniques were rejected for economic as well as ecologic reasons. With random or systematic sampling common communities would be oversampled and uncommon communities undersampled. In addition, plots falling on ecotones, disturbed, or early seral communities would either have to be rejected or would provide samples of little use for developing a habitat type classification (Pfister et al. 1977).

Plots were established within portions of stands that appeared to be relatively uniform in topography and vegetative structure. Efforts were made to locate plots to accurately represent tree and undergrowth composition, stocking and visible site factors of the stand.

Extensive use was made of 7.5' topographical maps to locate potential plot locations. Use of resource management maps provided by local BLM and Forest Service scientists was valuable for showing potential plot locations.

Both reconnaissance plots and analytical plots were included in

the sample of plots (Daubenmire and Daubenmire 1968; Franklin et al. 1970; Pfister and Arno 1980; Moir and Ludwig 1983). Analytic plots were used to check and calibrate accuracy of vegetation coverage as estimated by the reconnaissance plot method (Pfister and Arno 1980). The reconnaissance method is more rapid than the analytic plot method by a factor of two or three. Our procedures for both analytic and reconnaissance plot sampling followed those described by Moir and Ludwig (1983).

A total of 617 plots were sampled. In addition, in 443 of the 617 study plots a complete soil profile description was made for a soil pit in the center of each plot. The soils were classified to the subgroup level of soil taxonomy (Soil Survey Staff 1975). Ideally, soil descriptions should be complete enough to classify to family level. Caution is necessary in making generalizations concerning this soils information for four reasons. First, time constraints limited most pit depths to 50 cm. Generally 150 cm-deep pits are used when describing southwestern forest soils (Gass et al. 1981). Second, only thickness, structure, texture, color, and coarse fragment content of each horizon were recorded for each pedon. Third, descriptions are based solely on field observations; no samples were collected for laboratory verification of field descriptions. Fourth, our sample of plant associations does not necessarily cover the most widespread soil types. For example, Inceptisols may be over-represented since they occur on the steep, relatively undisturbed, terrain on which many of the plot samples were located. Alfisols typically occur on gently sloping sites which are more disturbed by logging and grazing; thus were sampled less in this study.

Documentary color and/or black and white photographs (35 mm) were taken in each plot.

Data Analysis

At the end of each field season, plant voucher collections were identified and species field codes were replaced by the known species on the field forms. This refined field data was then computer coded in a compact- efficient form and verified for accuracy using error-checking computer programs developed by one of us (JAL). Complete plot locations data, e.g., UTM and English coordinates, were then recorded from plot locations marked on the 7.5' topographical maps. This and site-soil data was computer coded in a standard format. This coded data was stored on punch cards, on magnetic tape and disk (kept in separate locations for security).

Once the plot data was coded and verified, the data was analyzed using the successive approximation classification strategy outlined by Pfister and Arno (1980) and Moir and Ludwig (1983). Basically, ordination (Pielou 1977), and releve' table manipulations (Shimwell 1971) were used to develop a preliminary habitat type classification. Evaluation of the objective results obtained by quantitative analyses was tempered by subjective ecological intuition.

Site index (100 year base age) of each plot was estimated for Picea engelmannii, Pseudotsuga menziesii, and Pinus ponderosa, where appropriate. Picea engelmannii site index estimates are based on curves developed by Alexander (1967), while Pseudotsuga menziesii and Pinus ponderosa site index estimation follows Edminster and Jump (1976) and Minor (1964), respectively.

Keys and descriptions for each habitat type were written. The result is this final habitat type classification for the forests of northern New Mexico and southern Colorado.

Soils and vegetation relationships, successional trends, management implications, tree productivity (based on site index), and relationships to other habitat type classifications in the Rocky Mountains were also described for each habitat type. Such descriptions must be considered with caution since they are based only on the data takin in developing the classification. More accurate elucidation of these relationships would require specifically designed major studies. Particular caution is necessary in relating the habitat types described here to those described in other areas. Composition of the entire stands need to be considered since the species complement varies geographically (Pfister 1972).

Taxonomic Considerations

Nomenclature follows Harrington (1954) except for revisions suggested in Weber and Johnston (1979). Revised names of major species in this study and their synonyms are listed in Table 1 (see Appendix for complete species list)

Certain species were difficult to identify in the field. Particularly difficult was the identification of Vaccinium scoparium versus V. myrtillus since the mature fruits needed to definitively seperate these species were rarely available. V. scoparium gains dominace over V. myrtillus in colder and drier environments (Peet 1981), but the ranges of the two species overlap for the most part. Since V. scoparium and V. myrtillus are closely similar ecologically (Pfister et al. 1977), all specimens keying to either V. scoparium or V. myrtillus in this study were lumped under the name Vaccinium myrtillus (the more common of the two species). Similarly, the necessary fruits were rarely available for the distinction of Thermopsis divaricarpa from T. montana and Lathy-

rus leucanthus from L. arizonicus. Thus, these species were lumped under the general headings of Thermopsis sp. and Lathyrus sp.

Many specimens of Pinus flexilis appeared to exhibit characteristics identifiable to P. strobiformis. However, since P. strobiformis is not recognized to occur north of central New Mexico (Little 1950), all specimens of this complex were referred to as P. flexilis.

In northern New Mexico, Quercus grisea occurs in addition to Q. gambelii. Hybrids between these species have been referred to as Q. undulata (Tucker 1961). In this study, those oaks with the most coriaceous subentire leaves are referred to as Q. undulata.

Carices were identified using Hermann's (1970) manual. Carices in the section Montanae were generally identified as Carex rossii if caespitose or as C. heliophila if rhizomitous. Additionally, Weber (1976) was an invaluable reference for field identification of many plants.

Table 1. Current nomenclature of some common plant species in the southern Rocky Mountain forests. The name used follows Weber and Johnston (1979). Synonyms follow Harrington (1954).

Growth Form	Name	Synonym
Shrub	*Clematis columbiana*	*C. pseudoalpnina*
Shrub	*Mahonia repens*	*Berberis repens*
Shrub	*Orthilia secunda*	*Pyrola secunda*
Shrub	*Rhus aromatica*	*R. trilobata*
Shrub	*Rubus idaeas*	*R. strigosus*
Shrub	*Swida sericea*	*Cornus stolonifera*
Grass	*Bromopsis ciliata*	*Bromus ciliatus*
Grass	*Koeleria macrantha*	*K. cristata*
Grass	*Schizachyrium scoparium*	*Andropogon scoparius*
Grass	*Sorghastrum avenaceum*	*S. nutans*
Forb	*Achillea millefolium*	*A. lanulosa*
Forb	*Anticlea elegans*	*Zygadenus elegans*
Forb	*Chamerion angustifolium*	*Epilobium angustifolium*
Forb	*Erigeron eximius*	*E. superbus*
Forb	*Heterotheca fulcrata*	*Chrysopsis villosa*
Forb	*Ipomopsis aggregata*	*Gilia aggregata*
Forb	*Ligularia amplectens*	*Senecio amplectens*
Forb	*Oreochrysum parryi*	*Happlopappus parryi*
Forb	*Polemonium pulcherrimum*	*P. delicatum*
Forb	*Senecio streptanthifolius*	*S. cymbalarioides*

Rationale, Perspective and Definitions

Among the most significant features of the habitat type system is that it delimits logical units for management, and allows prediction of such characteristics as timber and forage production potentials (Layser 1974; Pfister 1976). Additionally, habitat type classification provides a common system for improving communication among diverse investigators; and the classification is useful in improving sampling design and experimental layout (Pfister et al. 1977). Such usefulness provided the strongest rationale for selecting the habitat type classification approach for this forestland study in the southern Rocky Mountains.

Classifications of forestlands based on "single factor" analyses, such as, dominant vegetation, landforms, land uses, or soils, typically are either too general or lack the ecological basis needed for sound multiple-use management. In contrast, climax vegetation serves as a key to the integrated environment, including climate, soil, and landform conditions as they affect vegetal composition (Daubenmire 1976). Efficient and successful land management is more probable when a classification system is available for dividing the landscape into units of contrasting biotic potentials (Driscoll 1964). The habitat type classification of forests has proven to be very useful to land managers, as evidenced by its general acceptance and utility in those regions where such classifications have been completed and polished (Pfister and Arno 1980).

Use of climax plant associations (combination of climax tree and understory dominants) as site indicators is termed "habitat typing". "Cover type" and "habitat type" are not synonyms. Cover typing differs from habitat typing in that no consideration is given to successional

status (Layser and Schubert 1979). The cover type tells us something about the current cover but tells little if anything about the site. In contrast, habitat typing stresses potential climax and thus may not tell what cover currently exists, but it does communicate something about secondary succession, potential cover, and the site or environment (Layser and Schubert 1979).

Associations allow the recognition of more ecologically-distinct areas than would be possible if only understory or overstory were considered alone (Daubenmire and Daubenmire 1968). This is because overstory and undergrowth generally occupy the land independently. The same tree canopy can occur over almost wholly different ground covers. In general terms, one might hypothesize that the tree stratum is more closely tied to macroclimate whereas the understory is more sensitive to microclimate (Daubenmire and Daubenmire 1968).

Plots are grouped according to the tree species showing the strongest evidence of self perpetuation, i.e., the climax tree species. This is termed the "series" level of the classification (Pfister and Arno 1980). Each series was then subdivided based on the dominant or characteristic understory species in the climax community. Thus, habitat type names are two-part, e.g., Pinus ponderosa/Festuca arizonica; the first part of the name being the climax tree species and the second part the climax understory indicator species (Pfister and Arno 1980). Further, heterogeneous types were divided into phases. Phases represent "insipient" habitat types which are not at present considered distinct enough for recognition at the habitat type level. Habitat type names were chosen for brievity and for appropriateness in conveying a sense of a given range of environmental conditions. The name does not infer that the only species in the stand are those given

in the name. Co-dominance of two or more tree species at climax and the occurrence of 30 or more understory species is not uncommon.

Use of climax plant associations to name habitat types does not imply that we have an abundance of climax vegetation in the present landscape (Pfister et al. 1977; Steele et al. 1981). Most current vegetation reflects some form of disturbance and various stages of succession towards climax. Indeed, in areas where timber harvesting and overgrazing have been pervasive, climax vegetation structure is essentially absent. However, habitat types can usually be identified even in seral stands by noting the relative reproductive success of the species present in comparison with known successional trends (Pfister et al. 1977). Stands representing very early successional stages can often be identified to habitat type by comparison with adjacent mature stands having similar topographic and edaphic features (Arno 1982; Pfister et al. 1977).

Habitat type names do not imply that we should manage for climax vegetation. Forage production for livestock declines rapidly with advancement of succession in most western forest habitat types (Pfister 1971). However, even if the goal of management is the maintenance of seral vegetation, the usefulness of the climax concept remains unchanged.

Problems in developing a habitat type classification in highly disturbed areas may be lessened by basing the classification on many characteristics, in addition to climax vegetation. Once the classification has been developed based on many characteristics, the classes may often be recognized on the basis of a few easily observed characteristics such as vegetation composition and structure (Bailey et al.

1978). This concept of integrating more than one characteristic to identify relatively homogeneous units of land is expressed in ECOCLASS (Corliss 1974).

Plant communities and the soils supporting them are both functional products of the interaction of organisms, climate, geomorphology, parent material, and time (Jenny 1941; Major 1951). Therefore, it should be expected that direct relationships exist between the two complexes (Driscoll 1964). Although vegetation and soil correlations do not always occur (Daubenmire 1970) many investigators have reported such correlations (Anderson 1956; Despain 1973; Driscoll 1964; Spilsbury and Tisdale 1944; Tisdale 1947; Wentworth 1981). This correlation is a major element of the Terrestrial Ecosystem Survey (TES) procedure pioneered by the U. S. Forest Service in the Southwest (Gass et al. 1981). The failure of certain soil/vegetation correlations may be do to a "single factor" approach as opposed to an integrated approach as used in TES.

In a Montana study conducted by Munn et al. (1978), it was found that range habitat types and soil taxonomic units were related along moisture and soil development gradients. Further, Carleton et al. (1974) found strong relationships between soil moisture and temperature regimes (as defined in the Soil Taxonomy, Soil Survey Staff 1975) and potential natural vegetation in northern New Mexico.

RESULTS AND DISCUSSION

The following habitat type descriptions essentially represent refinement and expansion of those included in Ludwig et al. (1981). In identifying habitat types in the field, all descriptive material given in this chapter and in the Appendix tables and figures will prove useful in ascertaining the correct type. Ideally, since the classification was developed using mature, minimally-disturbed forest, identification of habitat type using the keys and descriptions given is best acheived through examining near-pristine vegetation.

The bulk of the descriptive materials presented here relate to non-riparian forests having soil profile development. Within such forests, three broad forest types are recognized: spruce-fir forest, mixed conifer forest, and ponderosa pine forest. Layser and Schubert (1979) provide general series descriptions for Southwestern forests. Series descriptions given herein represent refinement of their work for specific application to the northern New Mexico-southern Colorado study area. Generally, the order of habitat types described is from cold-moist to warm-dry.

Field identification of habitat types using this dissertation would best be accomplished in the following way:

1. Locate that portion of the stand that, in your judgement, best represents the stands typical vegetation. The tree canopy should be mature and the undergrowth should not be severely disturbed. Extrapolation from the nearest mature stand occupying a similar site may be necessary in some areas of widespread disturbance.
2. Note mature trees and their reproduction (by species) within the

stand. Particular attention must be given to tree reproduction; as reference to trees in the key primarily concerns regeneration since habitat types are based on "potential" climax, not necessarily current conditions.

3. Accurately identify and estimate cover of dominant shrubs and herbs within the stand and note presence of indicator species given in the key that may have minor cover in the stand sampled.
4. Note physical site features of the stand including elevation, aspect, percent slope, landform, and soil depth and coarse fragment content.
5. Identify the habitat type by following the key.
6. If difficulty arises in habitat type identification, compare the stand with the synoptic descriptions given for the series and types in question and decide which best fits the stand characteristics.
7. If it becomes apparent that a undescribed habitat type has been found, the stand should be measured thoroughly or its precise location given to the U.S. Forest Service regional ecologist.

Use the definitions given below for canopy coverage terms in the key. In stands where dense shading or heavy duff accumulation has resulted in a unusually sparse undergrowth, adjust the definitions to the next lower coverage class.

Scarce = less than 1 % cover versus Common = greater than 1 % cover;

Poorly-represented = less than 5 % cover versus Well-represented = greater than 5 % cover; and

Abundant = greater than 25 % cover

Key to the Habitat Types

Forest Type Key

1. Forests of unstable rock-dominated slopes with poorly developed, variable understories---- SCREE

1. Forests on sites with soil development and somewhat uniform understories---- 2

2. Forests of streamsides with *Populus angustifolia* or *Alnus tenuifolia* generally present---- RIPARIAN

2. Forests of canyon sideslopes and ridges---- 3

3. *Abies lasiocarpa* and/or *Picea engelmannii* present and reproducing successfully---- Spruce-Fir Forests

3. *Abies lasiocarpa* and *Picea engelmannii* absent or minor- 4

4. *Abies concolor* and/or *Pseudotsuga menziesii* present and reproducing successfully---- Mixed Conifer Forests

4. *Abies concolor* and *Pseudotsuga menziesii* absent or minor ---- Ponderosa Pine Forests

Spruce-Fir Forests

1. Vascular plant understory very sparse (seldom exceeding 10% total cover)---- *Abies lasiocarpa*/MOSS HT

1. Understory well-developed---- 2

2. *Vaccinium* well-represented---- 3

2. *Vaccinium* poorly-represented or absent---- 6

3. *Linnaea borealis* or *Rubus parviflorus* well-represented ---- 4

3. *Linnaea borealis* or *Rubus parviflorus* poorly-represented or absent---- 5

4. *Linnaea borealis* well-represented ---- *Abies lasiocarpa*/*Linnaea borealis* HT

4. *Linnaea borealis* poorly-represented or absent ---- *Abies lasiocarpa*/*Rubus parviflorus* HT

5. *Polemonium pulcherrimum* ssp. *delicatum* or *Ligularia amplectens* common---- *Abies lasiocarpa*/*Polemonium pulcherrimum* HT

   a. *Picea engelmannii* climax ---- *Picea engelmannii* phase

   b. *Abies lasiocarpa* climax or co-climax ---- *Abies lasiocarpa* phase

5. Polemonium pulcherrimum ssp. delicatum or Ligularia amplectens scarce or absent
---- Abies lasiocarpa/Vaccinium myrtillus HT

6. Festuca thurberi or F. arizonica common; high elevation parkland
---- Pinus aristata/Festuca thurberi HT

6. Festuca thurberi or F. arizonica scarce or absent-- 7

7. Oxypolis fendleri or Cardamine cordifolia well-represented; forests of high elevation seep slopes
---- Abies lasiocarpa/Oxypolis fendleri HT

7. Oxypolis fendleri or Cardamine cordifolia poorly-represented or absent---- Abies lasiocarpa/Erigeron eximius HT
a. Rubus parviflorus well represented
---- Rubus parviflorus phase
b. Rubus parviflorus poorly represented or absent
---- Erigeron eximius phase

Mixed Conifer Forests

1. Vaccinium well-represented
---- Abies concolor/Vaccinium myrtillus HT

1. Vaccinium poorly-represented or absent---- 2

2. Picea pungens, Acer glabrum, or Erigeron eximius common
---- 3

2. Picea pungens, Acer glabrum, or Erigeron eximius scarce or absent---- 9

3. Picea pungens minor or absent relative to Abies concolor and Pseudotsuga menziesii---- 4

3. Picea pungens the indicated climax or co-climax---- 5

4. Acer glabrum dominant relative to Erigeron eximius or Bromopsis ciliata (shrubby understories)
---- Abies concolor/Acer glabrum HT

4. Acer glabrum minor or absent relative to Erigeron eximius or Bromopsis ciliata (herby understories)
---- Abies concolor/Erigeron eximius HT

5. Festuca arizonica well-represented
---- Picea pungens/Festuca arizonica HT

5. Festuca arizonica poorly-represented or absent---- 6

6. Linnaea borealis well-represented
---- Picea pungens/Linnaea borealis HT

6. Linnaea borealis poorly-represented or absent---- 7

7. Arctostaphylos uva-ursi well-represented
---- Picea pungens/Arctostaphylos uva-ursi HT

7. Arctostaphylos uva-ursi poorly-represented or absent---- 8

8. Carex foenea abundant---- Picea pungens/Carex foenea HT

8. Carex foenea less than 25% cover
---- Picea pungens/Erigeron eximius HT

9. Abies concolor common---- 10

9. Abies concolor scarce or absent---- 13

10. Arctostaphylos uva-ursi or Quercus gambelii well-represented---- 11

10. Arctostaphylos uva-ursi or Quercus gambelii poorly-represented or absent---- 12

11. Arctostaphylos uva-ursi well-represented
---- Abies concolor/Arctostaphylos uva-ursi HT

11. Arctostaphylos uva-ursi poorly-represented or absent
---- Abies concolor/Quercus gambelii HT

12. Festuca arizonica common
---- Abies concolor/Festuca arizonica HT

12. Festuca arizonica scarce or absent
---- Abies concolor/SPARSE HT

13. Pinus flexilis and Pseudotsuga menziesii co-dominant, Arctostaphylos uva-ursi well-represented
---- Pseudotsuga menziesii/Arctostaphylos uva-ursi HT

13. Pinus flexilis minor or absent, Arctostaphylos uva-ursi poorly-represented or absent---- 14

14. Quercus gambelii well-represented
---- Pseudotsuga menziesii/Quercus gambelii HT
a. Festuca arizonica present---- Festuca arizonica phase
b. Festuca arizonica absent---- Quercus gambelii phase

14. Quercus gambelii poorly-represented or absent
---- Pseudotsuga menziesii/Festuca arizonica HT
a. Pinus aristata present---- Pinus aristata phase
b. Pinus aristata scarce or absent
---- Pseudotsuga menziesii phase

Ponderosa Pine Forests

1. Arctostaphylos uva-ursi well-represented
   ---- Pinus ponderosa/Arctostaphylos uva-ursi HT

1. Arctostaphylos uva-ursi poorly-represented or absent---- 2

2. Quercus gambelii or Q. undulata well-represented---- 3

2. Quercus gambelii or Q. undulata poorly-represented or absent---- 5

3. Quercus undulata well-represented
   ---- Pinus ponderosa/Quercus undulata HT

3. Quercus undulata poorly-represented or absent---- 4

4. Pinus edulis common (with advanced regeneration)
   ---- Pinus ponderosa-Pinus edulis/Quercus gambelii HT

4. Pinus edulis scarce or absent
   ---- Pinus ponderosa/Quercus gambelii HT
   a. Festuca arizonica present---- Festuca arizonica phase
   b. Festuca arizonica absent or minor
      ---- Quercus gambelii phase

5. Bouteloua gracilis present---- 6
5. Bouteloua gracilis absent---- 7

6. Festuca arizonica present
   ---- Pinus ponderosa/Festuca arizonica HT,
   Bouteloua gracilis phase

6. Festuca arizonica absent
   ---- Pinus ponderosa/Bouteloua gracilis HT
   a. Schizachyrium scoparium well-represented
      ---- Schizachyrium scoparium phase
   b. Schizachyrium scoparium poorly-represented or absent
      ---- Bouteloua gracilis phase

7. Festuca arizonica or Danthonia parryi well-represented
   ---- Pinus ponderosa/Festuca arizonica HT
   a. Danthonia parryi present---- Danthonia parryi phase
   b. Danthonia parryi scarce or absent
      ---- Festuca arizonica phase

7. Festuca arizonica or Danthonia parryi poorly-represented or absent---- 8

8. Muhlenbergia montana common
   ---- Pinus ponderosa/Muhlenbergia montana HT

8. Muhlenbergia montana scarce or absent (woodlands on eolian sands)---- Pinus ponderosa/Oryzopsis hymenoides HT

The Habitat Type Classification

Spruce-Fir Forests

Pinus aristata Series

1. *Pinus aristata/Festuca thurberi* Habitat Type

GEOGRAPHY. *Pinus aristata/Festuca thurberi* is the only habitat type in the *Pinus aristata* series. The series occurs predominately at upper timberline in the San Juan Mountains and Sangre de Cristo Range of Colorado.

VEGETATION. *Picea engelmannii* and *Pinus aristata* typically co-dominate the overstory. However, in some stands one or another of these species may be dominant, the other minor or absent. *Abies lasiocarpa* is a minor component in this rather dry habitat type. This supports Peet's (1978) suggestion that *Picea engelmannii* is more drought tolerant than *Abies lasiocarpa*. *Festuca thurberi* is the most conspicuous understory component. *Ribes montigenum*, *Achillea millefolium* ssp. *lanulosa*, *Arnica cordifolia*, *Chamerion angustifolia*, *Oreochrysum parryi*, *Polemonium pulcherrimum* ssp. *delicatum*, *Saxifraga bronchialis*, *Thalictrum fendleri*, and *Trifolium dasyphyllum* are often present (Table 2).

PHYSICAL SETTING. The type is generally found on mid and upper slopes at elevations exceeding 3,200 m. The type largely occurs at upper timberline (Figure 2) but sometimes occurs elsewhere in the spruce-fir zone where tree growth is limited by drought. Soils vary from Cryorthents to Cryoborolls. The soils are characteristically skeletal, particularly in those situations where *Pinus aristata* is dominant.

Table 2. Species frequencies 'FRQ) and average tree density or shrub-herb cover (CVR) for northern New Mexico-southern Colorado spruce-fir habitat types.

HTS:	1*		2A		2B		3		4	
NO. PLOTS:	(7)		(15)		(38)		(14)		(62)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -										
ABIES CONCOLOR - YNG REGEN									6	<1
ABIES CONCOLOR - ADV REGEN									6	<1
ABIES CONCOLOR - MATURE									3	<1
ABIES LASIOCARPA - YNG REGEN	14	<1	67	2	100	63	100	37	97	64
ABIES LASIOCARPA - ADV REGEN			47	2	100	14	100	13	89	15
ABIES LASIOCARPA - MATURE			27	<1	95	4	86	2	77	3
PICEA ENGELMANNII - YNG REGEN	71	4	93	43	95	31	100	19	98	34
PICEA ENGELMANNII - ADV REGEN	86	3	100	24	95	14	93	9	95	14
PICEA ENGELMANNII - MATURE	57	2	100	14	100	11	100	10	94	7
PICEA PUNGENS - YNG REGEN									2	<1
PICEA PUNGENS - ADV REGEN									2	<1
PICEA PUNGENS - MATURE									2	<1
PINUS ARISTATA - YNG REGEN	71	3							2	<1
PINUS ARISTATA - ADV REGEN	71	7	7	<1					2	<1
PINUS ARISTATA - MATURE	86	5	7	<1					2	<1
PINUS FLEXILIS - YNG REGEN	14	<1							5	<1
PINUS FLEXILIS - ADV REGEN									6	<1
PINUS FLEXILIS - MATURE					3	<1			3	<1
POPULUS TREMULOIDES-YNG REGEN									13	<1
POPULUS TREMULOIDES-ADV REGEN									18	3
POPULUS TREMULOIDES-MATURE							7	<1	3	<1
PSEUDOTSUGA MENZIESII-YNG REG									8	<1
PSEUDOTSUGA MENZIESII-ADV REG									23	<1
PSEUDOTSUGA MENZIESII- MATURE									19	1
- - S H R U B S - -										
ACER GLABRUM									3	<1
JUNIPERUS COMMUNIS	14	<1	13	<1	3	<1			31	<1
LINNAEA BOREALIS									18	<1
LONICERA INVOLUCRATA			13	<1	58	<1	79	3	44	<1
MAHONIA REPENS									15	<1
MONESES UNIFLORA			27	<1	34	<1	79	<1	32	<1
ORTHILIA SECUNDA			40	<1	68	<1	79	<1	73	<1
PACHISTIMA MYRSINITES			7	<1			7	<1	47	<1
RIBES MONTIGENUM	43	<1	80	<1	66	<1	86	4	32	<1
RIBES WOLFII			20	<1	24	<1	43	<1	19	<1
RUBUS PARVIFLORUS									21	<1
VACCINIUM SP.			100	31	100	37	57	2	100	50
- - G R A M I N O I D S - -										
BROMOPSIS CILIATA	29	<1	53	<1	53	<1	79	<1	55	<1
CALAMAGROSTIS CANADENSIS							14	<1	5	<1
CAREX ROSSII	71	<1	47	<1	11	<1	7	<1	32	<1
FESTUCA THURBERI	100	22	7	<1					5	<1
LUZULA PARVIFLORA			60	<1	63	<1	100	2	18	<1
TRISETUM SPICATUM S. MONTANUM			13	<1	18	<1	36	<1	32	<1

Table 2. (continued)

HTS:	1		2A		2B		3		4	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - F O R B S - -										
ACHILLEA MILLEFOLIUM	86	<1	47	<1	11	<1	21	<1	18	<1
ACTAEA RUBRA SSP. ARGUTA					5	<1	14	<1	8	<1
ARNICA CORDIFOLIA	29	2	47	1	79	3	57	4	37	2
ARTEMISIA FRANSERIOIDES	43	<1							19	<1
BISTORTA VIVIPARA			27	<1	11	<1	36	<1		
CARDAMINE CORDIFOLIA							93	10		
CHAMERION ANGUSTIFOLIUM	71	<1	47	<1	42	<1	50	2	44	<1
ERIGERON COULTERI			20	<1	3	<1	29	2	2	<1
ERIGERON EXIMIUS			27	<1	55	2	29	<1	60	2
ERIGERON PEREGRINUS			20	<1	13	<1	29	<1	19	<1
FRAGARIA AMERICANA	14	<1	7	<1	5	<1	7	<1	5	<1
FRAGARIA OVALIS	29	<1	60	<1	47	<1	64	<1	81	<1
GALIUM TRIFLORUM							14	<1	2	<1
GERANIUM RICHARSONII	14	<1	7	<1	47	<1	79	3	45	<1
LATHYRUS SP.			7	<1	3	<1	21	<1	37	2
LIGULARIA AMPLECTENS			67	2	55	3	43	2		
LIGUSTICUM PORTERI			20	<1	53	<1	72	2	29	<1
MERTENSIA CILIATA	14	<1	53	<1	45	<1	100	13	15	<1
MITELLA PENTANDRA					13	<1	50	1	2	<1
OREOCHRYSUM PARRYI	43	<1	47	<1	55	<1	57	1	61	2
OSMORHIZA DEPAUPERATA	14	<1	20	<1	66	<1	86	2	47	<1
OXYPOLIS FENDLERI			20	<1	5	<1	93	18		
PEDICULARIS RACEMOSA			20	<1	79	2	57	<1	55	<1
POLEMONIUM PULCHERRIMUM	57	<1	100	6	97	3	79	2	6	<1
PSEUDOCYMOPTERIS MONTANUS	29	<1	60	<1	63	<1	50	<1	47	<1
SAXIFRAGA BRONCHIALIS	57	<1	20	<1	5	<1			6	<1
SAXIFRAGA ODONTOLOMA							57	5		
SENECIO ATRATUS	29	<1								
SENECIO TRIANGULARIS			7	<1			79	6		
SMILACINA RACEMOSA					5	<1	29	<1	19	<1
SMILACINA STELLATA	29	<1					14	2	11	<1
STREPTOPUS AMPLEXIFOLIUS					16	<1	71	1	6	<1
THALICTRUM FENDLERI	29	<1	7	<1	8	<1	57	1	21	<1
TRAUTVETTERIA CAROLINENSIS					5	2	7	2	6	<1
TRIFOLIUM DASYPHYLLUM	29	<1	13	2	3	<1				
VIOLA CANADENSIS			7	<1	24	<1	50	<1	29	<1

Table 2. (continued)

HTS:	5		6		7		8A		8B	
NO. PLOTS:	(14)		(21)		(7)		(40)		(11)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -										
ABIES CONCOLOR - YNG REGEN			29	4	14	<1	25	2		
ABIES CONCOLOR - ADV REGEN			29	<1	14	<1	22	<1		
ABIES CONCOLOR - MATURE			5	<1	14	<1	15	<1		
ABIES LASIOCARPA - YNG REGEN	93	38	100	68	100	59	97	38	100	65
ABIES LASIOCARPA - ADV REGEN	93	9	86	17	100	9	97	10	100	16
ABIES LASIOCARPA - MATURE	64	1	29	<1	71	2	57	2	82	3
PICEA ENGELMANNII - YNG REGEN	100	29	90	43	100	29	92	21	73	11
PICEA ENGELMANNII - ADV REGEN	100	26	70	13	100	8	90	9	73	7
PICEA ENGELMANNII - MATURE	100	8	76	5	100	6	85	6	100	6
PICEA PUNGENS - YNG REGEN			14	<1			7	<1		
PICEA PUNGENS - ADV REGEN			19	<1			5	<1		
PICEA PUNGENS - MATURE			10	<1			7	<1		
PINUS ARISTATA - YNG REGEN	14	<1								
PINUS ARISTATA - ADV REGEN	21	3								
PINUS ARISTATA - MATURE	14	<1								
PINUS FLEXILIS - YNG REGEN			19	<1						
PINUS FLEXILIS - ADV REGEN							5	<1	9	<1
PINUS FLEXILIS - MATURE							2	<1		
POPULUS TREMULOIDES-YNG REGEN	7	<1	14	<1	14	2	20	3	27	<1
POPULUS TREMULOIDES-ADV REGEN	14	<1	33	3			30	1	18	<1
POPULUS TREMULOIDES-MATURE	7	<1	5	<1			20	<1	27	<1
PSEUDOTSUGA MENZIESII-YNG REG	14	<1	48	11	29	5	27	1		
PSEUDOTSUGA MENZIESII-ADV REG	7	<1	52	3	43	2	35	1	27	<1
PSEUDOTSUGA MENZIESII-MATURE	29	<1	62	4	57	1	42	2	36	<1
- - S H R U B S - -										
ACER GLABRUM	7	<1	29	<1	43	2	22	<1	27	2
JUNIPERUS COMMUNIS	43	1	43	<1	14	<1	17	<1		
LINNAEA BOREALIS			100	25	14	<1	13	<1		
LONICERA INVOLUCRATA	14	<1	71	<1	100	3	52	1	82	2
MAHONIA REPENS	14	<1	24	<1	14	<1	27	<1	27	<1
MONESES UNIFLORA	7	<1	24	<1	14	<1	27	<1	18	<1
ORTHILIA SECUNDA	50	<1	90	<1	86	<1	75	<1	82	1
PACHISTIMA MYRSINITES	14	<1	57	6	71	4	50	2	73	2
RIBES MONTIGENUM	7	<1	24	<1	43	<1	57	1	36	<1
RIBES WOLFII			14	<1	43	1	27	<1	27	<1
RUBUS PARVIFLORUS			38	2	100	25	35	<1	100	15
VACCINIUM SP.	57	2	95	25	100	31	55	2	55	<1
- - G R A M I N O I D S - -										
BROMOPSIS CILIATA	29	<1	67	<1	100	<1	90	3	100	<1
CALAMAGROSTIS CANADENSIS			5	<1			10	<1		
CAREX ROSSII	64	<1	24	<1	29	<1	38	<1	9	<1
FESTUCA THURBERI					14	<1	7	<1		
LUZULA PARVIFLORA					14	<1	22	<1	18	<1
TRISETUM SPICATUM S. MONTANUM	29	<1	71	<1	71	<1	42	<1	55	<1

Table 2. (continued)

HTS:	5		6		7		8A		8B	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - F O R B S - -										
ACHILLEA MILLEFOLIUM	4	<1	10	<1	14	<1	30	1	18	<1
ACTAEA RUBRA SSP. ARGUTA	7	<1	24	<1	57	<1	25	<1	45	<1
ARNICA CORDIFOLIA	7	<1	57	2	100	3	47	2	100	6
ARTEMISIA FRANSERIOIDES	21	<1	43	2	71	2	40	2	36	2
BISTORTA VIVIPARA										
CARDAMINE CORDIFOLIA										
CHAMERION ANGUSTIFOLIUM	14	<1	48	<1	86	<1	52	<1	55	<1
ERIGERON COULTERI							10	<1	9	<1
ERIGERON EXIMIUS	43	<1	62	5	100	10	97	16	91	6
ERIGERON PEREGRINUS	36	<1	10	<1						
FRAGARIA AMERICANA			14	<1	14	<1	17	<1		
FRAGARIA OVALIS	79	<1	76	<1	86	<1	77	3	55	<1
GALIUM TRIFLORUM			10	<1	43	<1	17	<1	18	<1
GERANIUM RICHARSONII	7	<1	38	<1	100	5	72	4	82	3
LATHYRUS SP.	21	<1	29	3	71	3	60	2	73	2
LIGULARIA AMPLECTENS							5	<1		
LIGUSTICUM PORTERI	14	<1	19	<1	29	<1	40	<1	45	2
MERTENSIA CILIATA			19	<1	43	<1	40	2	73	<1
MITELLA PENTANDRA			5	<1			20	<1	9	<1
OREOCHRYSUM PARRYI	29	<1	81	3	100	7	75	6	91	9
OSMORHIZA DEPAUPERATA	14	<1	38	<1	100	<1	75	<1	82	<1
OXYPOLIS FENDLERI										
PEDICULARIS RACEMOSA	7	<1	10	<1	29	<1	17	<1	27	<1
POLEMONIUM PULCHERRIMUM			19	<1			10	<1		
PSEUDOCYMOPTERIS MONTANUS	50	<1	48	<1	14	<1	57	<1	45	<1
SAXIFRAGA BRONCHIALIS	21	<1	5	<1	14	<1	2	<1		
SAXIFRAGA ODONTOLOMA										
SENECIO ATRATUS	7	<1								
SENECIO TRIANGULARIS							2	<1		
SMILACINA RACEMOSA			38	<1	100	<1	42	<1	91	1
SMILACINA STELLATA					57	<1	45	<1	45	<1
STREPTOPUS AMPLEXIFOLIUS			14	<1	14	<1	27	<1	45	<1
THALICTRUM FENDLERI			14	<1	86	2	50	2	82	3
TRAUTVETTERIA CAROLINENSIS							5	1	9	3
TRIFOLIUM DASYPHYLLUM							2	<1		
VIOLA CANADENSIS	7	<1	48	<1	86	<1	72	2	100	1

* HT. 1 =PINUS ARISTATA/FESTUCA THURBERI HT
HT. 2A =ABIES LASIOCARPA/POLEMONIUM PULCHERRIMUM HT, PICEA ENGELMANNII PH.
HT. 2B =ABIES LASIOCARPA/POLEMONIUM PULCHERRIMUM HT, ABIES LASIOCARPA PH.
HT. 3 =ABIES LASIOCARPA/OXYPOLIS FENDLERI HT
HT. 4 =ABIES LASIOCARPA/VACCINIUM MYRTILLUS HT
HT. 5 =ABIES LASIOCARPA/MOSS HT
HT. 6 =ABIES LASIOCARPA/LINNAEA BOREALIS HT
HT. 7 =ABIES LASIOCARPA/RUBUS PARVIFLORUS HT
HT. 8A =ABIES LASIOCARPA/ERIGERON EXIMIUS HT, ERIGERON EXIMIUS PH.
HT. 8B =ABIES LASIOCARPA/ERIGERON EXIMIUS HT, RUBUS PARVIFLORUS PH.

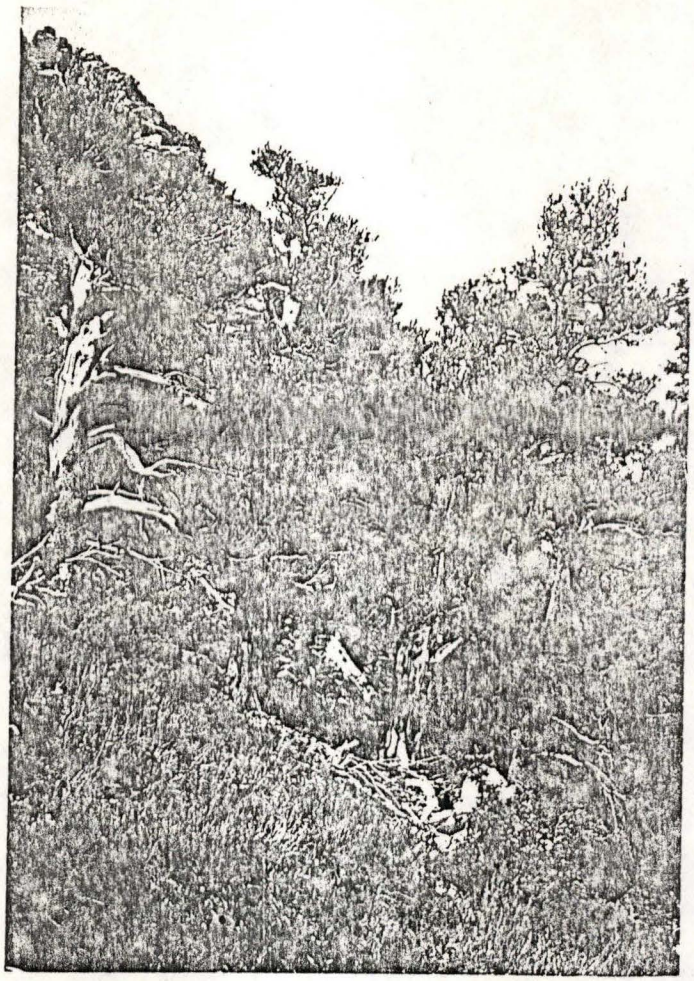

Figure 2. Pinus aristata/Festuca thurberi habitat type, Sangre de Cristo Range. This type is characteristic of the high elevation (here 3,510 m) forest-tundra ecotone.

ECOTONES. This type ecotones with Festuca thurberi grasslands in drier situations and with the Abies lasiocarpa/Polemonium pulcherrimum habitat type on moister sites (e.g., northerly or less-windy exposures)

COMMENTS. This type generally has a parkland appearance; with widely-spaced trees (occasionally clusters) interspersed with Festuca meadows. Owing to the strong representation of the highly palatable grass, Festuca thurberi, the grazing potential of this habitat type is high. However, the generally remote locations of examples of this

type make access difficult. This combined with the typically steep slopes (generally in excess of 50 percent) reduce the practicality of utilization of this habitat type for domestic grazing. Aesthetic attributes typically exceed economic ones, a prime consideration in management. Wildlife use, especially as summer range for elk, is an important characteristic of this type.

Fires are important within the type but seldom attain high enough intensity in the grass-dominated understory of these open forests to result in devastating crown-fires.

Areas where Pinus aristata is dominant or co-dominant generally represent drier situations and are found in more exposed situations. In some locations Festuca arizonica (a typically drier, lower elevation species than F. thurberi) occurs in association with F. thurberi.

Unlike situations within the Abies lasiocarpa/Polemonium pulcherrimum, the Abies lasiocarpa/Vaccinium myrtillus, or the Abies lasiocarpa/MOSS habitat types where Pinus aristata forms a minor seral component (Moir and Ludwig 1979). the more open forest situations in this type fail to give the more highly shade tolerant Picea engelmannii a competitive edge over Pinus aristata, and co-dominance of the two species, or, in some instances, sole occurrence of Pinus aristata is expressed. Layser and Schubert (1979) recognize a Pinus aristata series at high elevations. Too few plots were sampled in this study for such recognition.

Dix and Richards (1976) present data from a plot on Missionary Ridge in the San Juan Mountains of Colorado that fits the description of the Pinus aristata/Festuca thurberi habitat type. Additionally, Shepherd (1975) identified a Picea engelmannii-Festuca ovina-

Potentilla fruticosa-Achillea lanulosa habitat type in the Mosquito Range of central Colorado and Pfister et al. (1977) a Pinus albicaulis habitat type in Montana, which share environmental affinities with this type.

Abies lasiocarpa Series

GEOGRAPHY. This series occurs throughout the highest elevations of the study area. A high degree of similarity exists among habitat types within this series throughout the Rocky Mountains. In fact, habitat types within this series exhibit many floristic similarities with Eurasian boreal forests (Kornas 1972). Forests in this series are extensive and are of considerable economic importance.

VEGETATION. Most overstories exhibit co-dominance of Abies lasiocarpa and Picea engelmannii. However, young Abies typically outnumbers the less shade tolerant Picea; suggesting a tendency towards climax dominance by Abies (Pfister 1972). Abies has a furthur reproductive advantage in that both layering and reproduction by seed can occur while Picea reproduces strictly by seed (Hoffman and Alexander 1976). Picea is the more long-lived of the two species, however, so few pure Abies stands occur.

Following major disturbance, Populus tremuloides is a major seral species at the lower elevations of the series while upper elevations undergo direct successions to Picea and Abies. Lower elevations in this series support Abies concolor and Pseudotsuga menziesii as seral or minor climax components.

Understories are highly varied. Maximal mesic conditions are acheived within this series, i.e., in the Abies lasiocarpa/Oxypolis fendleri habitat type. Within the wet forests, species lists commonly

exceed 50 taxa in a given plot. Maximal cold conditions are also achieved within this series; in the Abies lasiocarpa/Polemonium pulcherrimum habitat type. The cold environment is substantiated by occurrence of floristic elements of the tundra often being present.

The single most characteristic understory component of most plant communities in the Abies lasiocarpa series is Vaccinium sp.. Havas (1971) suggests the distribution of Vaccinium sp. is limited by winter snow accumulation and persistance; snow being necessary to prevent dessication. The occurrence of Vaccinium sp. is thus suggestive of cold, snowy environments characteristic of the Abies lasiocarpa series.

PHYSICAL SETTING. At the highest elevations in the series (~,600 m), environments include cirques and other cold sites that retain snow cover late into summer, while lower elevations (~,700 m) are relatively warm. All landform types occur within the series, ranging from dry-exposed ridges (Abies lasiocarpa/MOSS habitat type) to wet-sheltered seep slopes (Abies lasiocarpa/Oxypolis fendleri habitat type). Soils are all in cryic great groups.

ECOTONES. At its upper limit, the Abies lasiocarpa series borders alpine tundra. At its lower limit, the series ecotones to the Picea pungens series and herb-rich habitat types in the Abies concolor series on moist sites, and to herb-sparse Abies concolor habitats on dry sites.

COMMENTS. Timber productivity is generally limited by the rigorous subalpine environment. Lower elevation sites have the highest timber potentials. Timber management at low elevations may favor either

Picea engelmannii or Pseudotsuga menziesii. However, caution is necessary when managing for Pseudotsuga since frost-damage to regeneration may be severe. Wet habitats within the series require special care during timber harvests to prevent severe soil compaction, erosion, and conversion to sedge communities.

Heavy snow accumulations within the series make the preservation of watershed attributes a prime management directive. Also, the high esthetic value of forests in the Abies lasiocarpa series make them favored by recreationists. The rate of recovery following major disturbance is slow (Pfister 1976). Thus, heavy timber harvests will impact recreational use for long periods.

Domestic forage production is generally poor except in localized valley bottom sites. Big game species utilize forests and adjacent non-forested communities as summer range.

Fire has played a major role in the ecology of portions of this series as evidenced by extensive Populus tremuloides stands. The large area of such seral communities and often scant conifer seed source makes alteration by fire evident for decades or even centuries (Steele et al. 1981). Snow avalances often occur at the upper elevations, and result in mosaics of varying stages of forest development.

2. Abies lasiocarpa/Polemonium pulcherrimum Habitat Type

GEOGRAPHY. The Abies lasiocarpa/Polemonium pulcherrimum habitat type is widespread in the highest elevations of northern New Mexico and southern Colorado. It occurs in all mountain ranges exceeding 3,200 m.

VEGETATION. At the highest elevations, Picea engelmannii dominates

the overstory while slightly lower elevations within the type exhibit co-dominance of Picea and Abies lasiocarpa. Pinus aristata is sometimes present as a seral tree near the forest-tundra ecotone. The type is above the elevational limits of Populus tremuloides.

Understories are characterized by Vaccinium sp. (ranging in cover from 5 to 95 percent) and such cold indicator species as Luzula parviflora, Polemonium pulcherrimum ssp. delicatum, and Ligularia amplectens (Table 2; Figure 3).

Two phases are recognized:

Picea engelmannii phase: Picea is climax

Abies lasiocarpa phase: Abies is climax or co-climax

Figure 3. Abies lasiocarpa/Polemonium pulcherrimum habitat type, San Juan Mountains. The highest elevation (here 3,300 m) spruce-fir forests are represented by this type. Common understory species in this stand are Vaccinium myrtillus, Polemonium pulcherrimum, Ligularia amplectens, and Erigeron eximius. The meter stick banded into five 2-dm segments is used for scale.

PHYSICAL SETTING. This type occurs at upper timberline and shares

many characteristics with the Abies lasiocarpa/Luzula hithchcockii habitat type described in Montana by Pfister et. al. (1977) and in Idaho by Steele et. al. (1981). The type often occurs in cirques and other cold sites that retain snow cover late into the summer at elevations ranging from 3,000 to 3,600 m; with plots in the Picea phase generally on sites in excess of 3,400 m and Abies phase generally less than 3,500 m. The type occurs on all aspects and on moderate to steep slopes.

Soil great groups represented (in decreasing order of extent) are Cryoboralfs, Cryoborolls, and Cryochrepts.

ECOTONES. While the upper limit of the type typically borders alpine tundra, in some instances it ecotones to the Pinus aristata/Festuca thurberi habitat type occur. Interfingering with the very wet Abies lasiocarpa/Oxypolis fendleri habitat type occurs in the San Juan Mountains of Colorado where seeps are common at high elevations. Ecotones occur with Abies lasiocarpa/MOSS habitat type on drier exposures. In almost all locations the type is bounded at lower elevations by Abies lasiocarpa/Vaccinium myrtillus habitat type.

COMMENTS. Abies lasiocarpa/Polemonium pulcherrimum habitat type was first recognized by Moir and Ludwig (1979). The fact that the type is generally restricted to the coldest extremes of forest growth is substantiated by floristic elements of the tundra often being present. For example, such species as Deschampsia caespitosa, Acomastylis rossii, Bistorta vivipara, Sibbaldia procumbens, and Trifolium dasyphyllum are commonly found.

Snowfall and snow accumulation surpasses that of all other habi-

tat types in the study area. Dix and Richards (1976) note that Vaccinium sp. and Polemonium pulcherrimum both increase in frequency with increase in snow duration. Havas (1971) suggests the distribution of Vaccinium sp. is limited by winter snow accumulation and persistance; snow being necessary to prevent dessication.

If timber harvests are preformed, shading of Picea engelmannii regeneration is necessary to prevent insolation damage (Ronco 1970). Partial cuttings are likely to incur heavy blowdown losses (Alexander 1973). The rigorous subalpine environment of this type severly limits timber productivity. Since snow accumulations are typically significant watershed attributes are a prime consideration for management. Additionally, aesthetic values for recreational pursuits are high.

Highly-similar types have been reported from the central Rocky Mountains. Peet (1981) describes Xeric and Subalpine Picea, Abies forest communities near the tundra-forest ecotone in Rocky Mountain National Park, Colorado. Shepherd (1975) reports a Picea engelmannii-Ribes montigenum-Polemonium delicatum-Bromus sp. habitat type in the Mosquito Range of central Colorado. High elevation plots in the Abies lasiocarpa/Vaccinium scoparium habitat type in Utah (Pfister 1972) exhibit high Polemonium constancy. Additionally, affinities occur with the Picea engelmannii-Abies lasiocarpa/Salix pseudosapponum habitat type described in central Colorado (Hess and Wasser 1982). The Sibbaldia-Bistorta phase of the Abies lasiocarpa/Vaccinium scoparium habitat type in southeastern Wyoming (Wirsing and Alexander 1975) is also similar to the Polemonium type described here.

3. Abies lasiocarpa/Oxypolis fendleri Habitat Type

GEOGRAPHY. This habitat type is restricted to wet seep slopes in the high San Juan and Sangre de Cristo mountains.

VEGETATION. Picea engelmannii and Abies lasiocarpa co-dominate the overstory. The most conspicuous feature of the vegetation in this type is not the overstory, but the understory (Figure 4). Total herb cover in excess of 100 percent is common. Often five or more species will be abundantly represented in the understory. Species lists commonly exceed 50 taxa within a given plot. Thus, richness and luxuriant herbaceous growth characterize this type. The understory is patchy- reflecting variations in soil moisture.

Dominant wet-site species having a high fidelity for this type include: Carex bella, Cardamine cordifolia, Erigeron coulteri, Geranium richardsonii, Ligusticum porteri, Mertensia ciliata, Mitella pentandra, Oxypolis fendleri, Saxifraga odontoloma, Senecio triangularis, and Streptopus amplexifolius (Table 2). Dry hummocks, such as around tree bases, support Vaccinium sp. and Polemonium pulcherrimum ssp. delicatum.

PHYSICAL SETTING. Slopes are typically slight to moderate and aspects are generally northerly. Elevations vary from 2,800 to 3,400 m. Topographic positions on which this type occurs typically are lower slopes and mid slopes. Soils are characteristically deep and exhibit high water tables. Soil subgroups include Aquic Cryoboralfs, Argiaquic Cryoborolls, Argic Pachic Cryoborolls, and Aquic Cryofluvents.

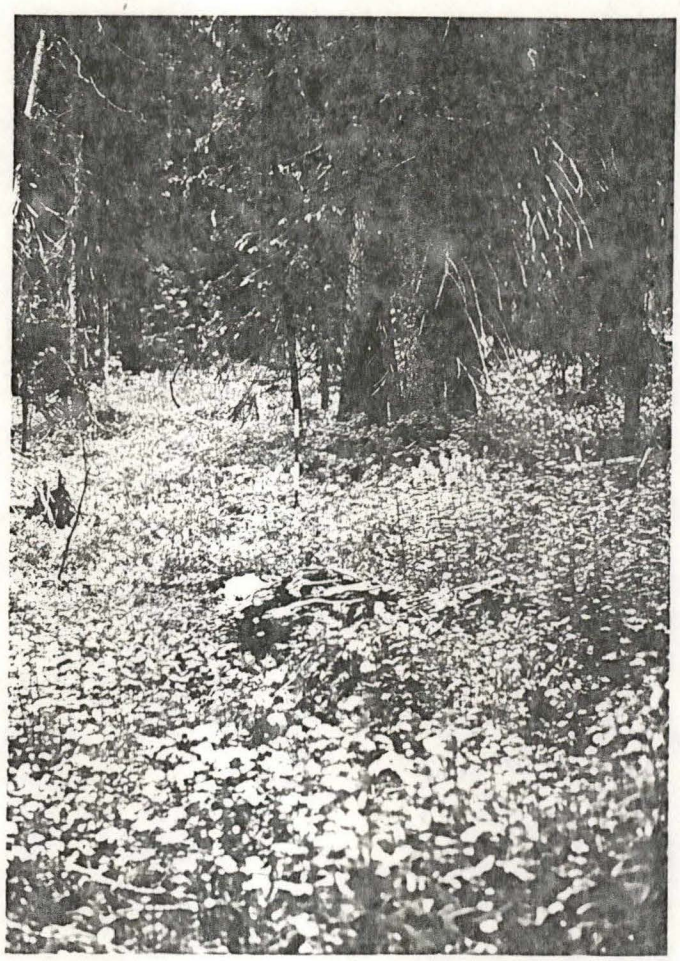

Figure 4. Abies lasiocarpa/Oxypolis fendleri habitat type, San Juan Mountains. This type is characterized by high water tables and forb-rich understories. Well-represented species in this stand are Oxypolis fendleri, Cardamine cordifolia, Senecio triangularis, and Caltha leptosepala.

ECOTONES. Commonly where seeps emerge in areas dominated by the Abies lasiocarpa/Polemonium pulcherrinum habitat type, the Oxypolis type occupies the seep areas. Wet meadows (dominated by Carex sp. and Juncus sp.) adjoin the type in some areas.

COMMENTS. This habitat type represents the wettest non-riparian habitat type of the southern Rocky Mountains. The moist conditions favor long fire-cycles and the typically sheltered topographic position

reduce the occurrence of extensive wind-throw. Thus, many forests of this type occur in climax conditions (Peet 1981).

Typically, seep areas form a minor component of the landscape and this habitat type would not be a consideration in management. However, some areas have extensive high elevation seep slopes. In such areas, the fragile A-uic soils make conventional silvicultural operations difficult. Skidding of logs can cause damage to the soil via compaction and accelerated erosion. Use of heavy equipment can be particularly damaging in the spring and early summer when water tables are highest. Further, clearcutting often results in the formation of dense Carex communities unsuitable to the establishment of conifers except after considerable site preparation.

The abundant forage and nearness to streams attract livestock. Compaction of the wet soil and loss of plant cover by livestock may be severe. Wildlife use may be high since abundant food and cover is present for elk, deer, and black bear. In addition, elk and bear can make wallows in wet spots.

This habitat type is important as watershed and the preservation of this attribute is a prime management directive.

Dix and Richards (1981) present data from two plots near Wolf Creek Pass in the San Juan Mountains of Colorado classifiable as the Abies lasiocarpa/Oxypolis fendleri habitat type. Peet (1981) describes a Wet Picea, Abies forest community in northern Colorado that is equivalent to the Abies lasiocarpa/Oxypolis fendleri habitat type. Steele et al. (1981) and Pfister et al. (1977) describes a Abies lasiocarpa/Calamagrostis canadensis habitat type that has affinities to the type described here. In addition, Steele et al. (1981) reports

a closely-related Abies lasiocarpa/Streptopus amplexifolius habitat type.

4. Abies lasiocarpa/Vaccinium myrtillus Habitat Type

GEOGRAPHY. This is one of the most widespread habitat types not only in the southern Rockies but throughout the high elevations of the Rocky Mountain system (Hoffman and Alexander 1980). It has been described in the southern Rockies (Fitzhugh et al. 1983; Moir and Ludwig 1979), in the central Rockies (Hess and Wasser 1982; Hoffman and Alexander 1976, 1980; Peet 1981; Pfister 1972; Wirsing and Alexander 1975), and in the northern Rockies (Daubenmire and Daubenmire 1968; Pfister et al. 1977; Steele et al. 1981). The type is most poorly represented in that part of the Rockies where the oceanic climatic influence is strongest, i.e., eastern Washington and northern Idaho (Daubenmire and Daubenmire 1968). Abies lasiocarpa/Vaccinium myrtillus habitat type occurs in all high mountains of northern New Mexico and southern Colorado. The major importance of the type in the study area is supported by the fact that it represents 62 of the 231 spruce-fir plots sampled in this study.

VEGETATION. Picea engelmannii and Abies lasiocarpa co-dominate the climax overstory. Few stands exhibit Picea dominance over Abies as was found (and described as a Picea engelmannii phase) in southern New Mexico and Arizona by Fitzhugh et al. (1983). There is little evidence that Abies would eventually replace Picea as has been suggested by Pfister (1972). Pseudotsuga menziesii and Populus tremuloides occur as seral trees in some stands. Pinus contorta is indicated as being a major seral species in this type in most other areas in the Rockies (Daubenmire and Daubenmire 1968; Hess and Wasser 1982;

Hoffman and Alexander 1976, 1980; Peet 1981; Pfister 1972; Pfister et al. 1977; Steele et al. 1981; Wirsing and Alexander 1975). However, Pinus contorta reaches its southern range limits in southern Colorado and was not found in any plots of this type within the study area.

Vaccinium sp. dominates the understory in plots of this type and species diversity is typically low. However, in moister situations herbaceous species may attain total covers in excess of 30 percent. In any case, high cover of Vaccinium sp. relative to other species is diagnostic for this type (Figure 5).

Important understory species, in addition to Vaccinium sp., include Lonicera involucrata, Orthilia secunda, Pachistima mrysinites, Ribes montigenum, Arnica cordifolia, Fragaria ovalis, Oreochrysum parryi, Pedicularis racemosa and Bromopsis ciliata throughout the type (Table 2). Erigeron eximius is important in moist-warm sites and Mertensia ciliata in wet microsites throughout the type.

PHYSICAL SETTING. Elevations range from 2,700 to 3,400 m and the type occurs on all aspects and on moderate to steep slopes. Many south-facing slopes in this type are burned-over and are in Populus tremuloides or other seral stages (Moir and Ludwig 1979). Soil great groups represented include Cryoboralfs, Cryoborolls, Cryochrepts, and Cryorthents.

ECOTONES. Ecotones occur with Abies lasiocarpa/MOSS habitat type on drier exposures. The Abies lasiocarpa/Erigeron eximius or Abies lasiocarpa/Linnaea borealis habitat type commonly form the low elevation ecotone with this type while upper elevation ecotones are with Abies lasiocarpa/Polemonium pulcherrimum habitat type.

Figure 5. Abies lasiocarpa/Vaccinium myrtillus habitat type, San Juan Mountains. This is the most widespread habitat type in the spruce-fir zone. Vaccinium dominates the understory. In this stand, Mahonia repens is well-represented. The large tree in the center is Pseudotsuga menziesii.

COMMENTS. In contrast to the Abies lasiocarpa/Polemonium pulcherrimum habitat type, tundra plants are generally absent from this type and snowfall is generally not retained as long (Dix and Richards 1976). Also, in contrast to the Polemonium type where Populus tremuloides is a minor seral species, it is major seral in this type. Understories are herb-rich beneath early-successional Populus canopies in this type (Moir and Ludwig 1979). Dominant herbs can include Lathyrus sp., Thermopsis sp., Geranium richardsonii, Thalictrum fendleri and Bromopsis ciliata. Vaccinium sp. presence despite herb-dominance is suggestive of the Abies lasiocarpa/Vaccinium myrtillus habitat type.

The relationship between Abies lasiocarpa/Vaccinium myrtillus and Abies lasiocarpa/Erigeron eximius habitat type is close. Shifts from

Vaccinium-dominated to herb-dominated understories probably reflect a gradient of increasing temperature (Moir and Ludwig 1979).

Timber productivity is poor to moderate. Abies reproduction is generally heavier than Picea under tree canopies. Cutting will favor Abies lasiocarpa in the replacement stand (Hoffman and Alexander 1976). Wet variants of this type (as indicated by herb-rich conditions) are generally subject to conversion to sedge fields following clearcutting. This condition presents severe problems for regeneration. Drier areas exhibit slow understory vegetation change following cutting and competition is not severe between tree seedlings and understory vegetation (Hoffman and Alexander 1980).

The Abies lasiocarpa/Vaccinium myrtillus habitat type characteristically provides poor grazing for livestock due to short growing season, limited numbers of forage species, and shade from the generally continuous tree canopy (Steele et al. 1981). However, it does provide valuable summer range for big game. Summer recreational use may be high.

As with other high elevation habitat types, one of the most important management considerations is the types watershed value (Leaf 1975). This is particularly significant in view of the types widespread nature and the characteristically deep snowpack it receives.

This boreal forest habitat type exhibits many floristic similarities with Eurasian boreal forests. In fact, some species are of circumboreal range, e.g., Goodyera repens and Moneses uniflora. There are few species in the boreal forests of either North America or Eurasia that are not represented by the same or closely-related species in the other (Kornas 1972).

5. Abies lasiocarpa/MOSS Habitat Type

GEOGRAPHY. This habitat type is primarily restricted to the Sangre de Cristo, San Pedro, and Jemez mountains of northern New Mexico.

VEGETATION. Picea engelmannii and Abies lasiocarpa typically co-dominate in the overstory and Populus tremuloides (occasionally Pinus aristata) is a minor seral tree. At lower elevations in this habitat type elements of the mixed conifer zone become evident (Fitzhugh et al. 1983). Diagnostic of this is the presence of Pseudotsuga menziesii as a seral component and the presence (in trace amounts only) of Acer glabrum. Vascular plants are minor in the understory of this comparitively dry habitat (Figure 6). Vaccinium sp., Juniperus communis, or Acer glabrum occasionally attain 10 percent cover (Table 2). Vaccinium cespitosum was found to be an important diagonostic species in northern New Mexico (Moir and Ludwig 1979). However, moss cover is the only prominent feature of the understory. The sparseness of the understory in this type relates to the generally severe character of the sites.

PHYSICAL SETTING. Elevations range from 3000 to 3500 m and slopes vary from gentle to steep. Generally, the type occurs on ridges or upper slopes at any aspect.

ECOTONES. This type lies within the elevational range of the Picea engelmannii/Polemonium pulcherrimum habitat type and the Abies lasiocarpa/Vaccinium myrtillus habitat type and ecotones with them in less exposed situations.

Figure 6. Abies lasiocarpa/MOSS habitat type. Sparse understory vascular plant cover is characteristic of this type.

COMMENTS. This type was first described in spruce-fir forests of Arizona and New Mexico by Moir and Ludwig (1979). Related types include the Picea engelmannii, Pinus aristata, Trifolium dasyphyllum, Poa habitat type (Shepherd 1975) and the Pinus contorta forest community (Peet 1981) of central Colorado. Affinities also exist with Abies lasiocarpa/Juniperus communis habitat type as described in central Idaho (Steele et al. 1981). Dix and Richards (1976) provide data from one stand on Missionary Ridge in the San Juan Mountains of Colorado that is identifiable as this Abies lasiocarpa/MOSS habitat type.

Site quality is poor within this type and management alternatives are limited . Livestock find little forage and seldom use this habitat type. The type does provide cover for elk and deer that feed in adjacent habitat types.

6. Abies lasiocarpa/Linnaea borealis Habitat Type

GEOGRAPHY. This habitat type is geographically common but topographically restricted. The type is most common in the San Juan Mountains of Colorado and in the Sangre de Cristo Range of Colorado and New Mexico.

VEGETATION. This type occurs at the ecotone of spruce-fir and mixed conifer forest and thus supports many species in common with both cover types. Abies concolor, Pseudotsuga menziesii, Populus tremuloides, and Pinus contorta (in Colorado) are important seral trees. The wealth of tree species makes description of forest development following disturbance difficult (Peet 1981). Understories are typically herb-rich with Vaccinium sp. and Linnaea the dominant understory indicators. In drier situations within the type, Rubus parviflorus is dominant relative to Linnaea. Pachistima myrsinites, Arnica cordifolia, Artemesia franseriodes, Erigeron eximius, Frageria ovalis, Lathyrus sp., Oreochrysum parryi, and Viola canadensis are often high in cover (Table 2). Abundant moss cover is suggestive of the moist conditions of this type (Figure 7).

PHYSICAL SETTING. The type occurs predominately on north and northeast-facing mid and lower slopes at lower elevations in the Abies lasiocarpa series (2,650 - 3,000 m). Soils include Cryoborolls, Cryoboralfs, and Cryorthents.

ECOTONES. The type shows affinities to both the Abies lasiocarpa/Erigeron eximius and Abies lasiocarpa/Vaccinium habitat types, and ecotones with them on warmer and colder sites, respectively. Lower elevations of similar topography may support Picea pungens/Linnaea borealis habitat type.

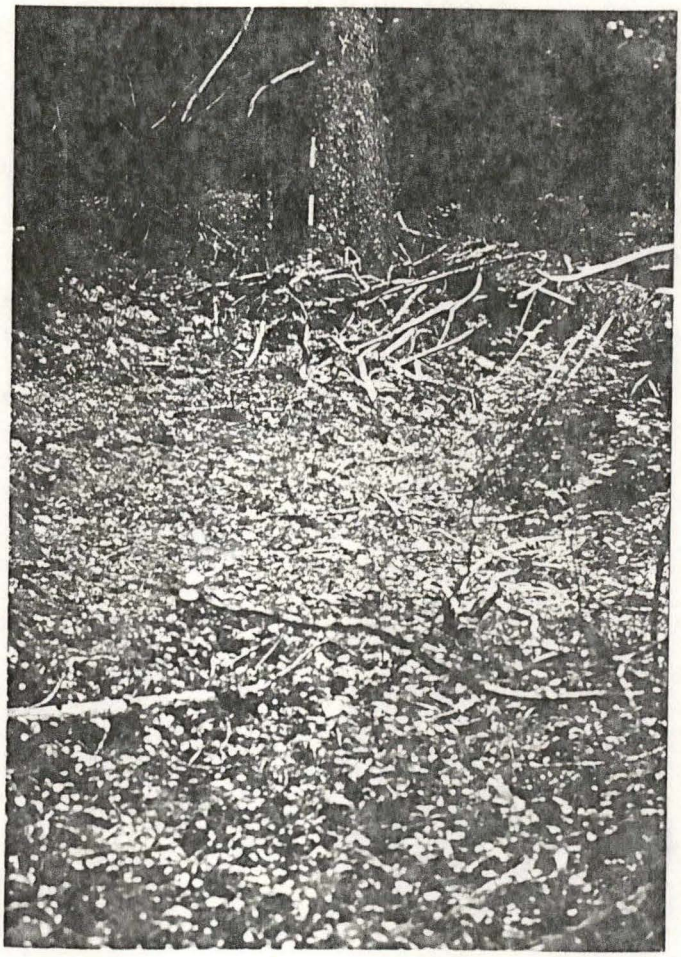

Figure 7. Abies lasiocarpa/Linnaea borealis habitat type, San Juan Mountains. Characteristically, this type occurs on moist northeasterly exposures at lower elevations (here 2,730 m) in the spruce-fir zone. In addition to understories rich in vascular plant species, moss cover is typically abundant (35 percent cover in this stand).

COMMENTS. This type has been previously described by Moir and Ludwig (1979). It shows close affinities to the Abies lasiocarpa/Linnaea borealis habitat type described in Montana (Pfister et al. 1977) and in Idaho (Steele et al. 1981), which also have a strong complement of Vaccinium. Similarly, the Picea engelmannii-Abies lasiocarpa/Pachistima myrsinites habitat type (Hess and Wasser 1982) and the Mixed mesic forest community (Peet 1981) of central Colorado share affini-

ties with the Linnaea type described here.

Timber productivity is generally low. Either Picea engelmannii or Pseudotsuga menziesii may be considered for timber management. When managing for Pseudotsuga frost-damage may be severe (Pfister et al. 1977).

Value for domestic grazing is low owing to limited grass production. Big game browse is typically good due to diverse shrub and forb layers. Vaccinium fruits may be important feed for grouse and black bear. Water yield is quite high.

7. Abies lasiocarpa/Rubus parviflorus Habitat Type

GEOGRAPHY. This habitat type is restricted to well-watered portions of Colorado's San Juan Mountains.

VEGETATION. Both Abies lasiocarpa and Picea engelmannii dominate the climax overstory. Pseudotsuga menziesii and Populus tremuloides are major seral species.

Understories are rich and suggestive of the well-watered conditions of this habitat type (Figure 8). Dominant shrubs include Acer glabrum, Lonicera involucrata, Pachistima myrsinites, Rubus parviflorus, and Vaccinium mrytillus. Common herbs are Arnica cordifolia, Artemesia franseriodes, Erigeron eximius, Geranium richardsonii, Lathyrus sp., Oreochrysum parryi, and Thalictrum fendleri (Table 2).

PHYSICAL SETTING. This type most commonly occurs on steep, northerly, lower slopes in the 2,500 to 2,900 m elevational range. Soils are predominantly Typic Cryoboralfs.

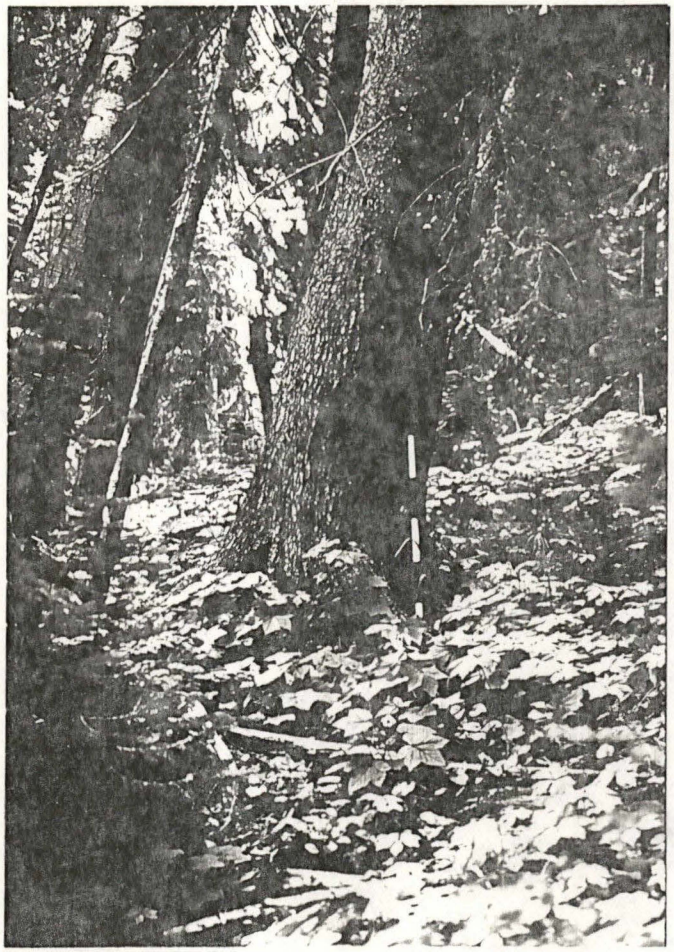

Figure 8. Abies lasiocarpa/Rubus parviflorus habitat type, San Juan Mountains. This type features shrub and herb-rich understories in typically steep, lower slopes. Prominent in this stand are Rubus parviflorus, Trautvetteria carolinensis, Erigeron eximius, and Smilicina racemosa.

ECOTONES. The Abies lasiocarpa/Rubus parviflorus habitat type ecotones with the analogous Abies lasiocarpa/Linnaea borealis habitat type. Ecotones also occur with the Abies lasiocarpa/Erigeron eximius and Abies lasiocarpa/Vaccinium myrtillus habitat type on warmer and colder sites, respectively. Since the type occurs at the lower boundary of the spruce-fir zone, ecotones to cold-moist mixed conifer habitat types are often encountered.

COMMENTS. This type is closely-related to the Abies lasiocarpa/Rubus parviflorus habitat type of southwestern New Mexico as described by Fitzhugh et. al. (1983) and Moir and Ludwig (1979). The type is characteristic of those forests in the southwestern United States receiving the highest growing season precipitation (Moir and Ludwig 1979).

Timber productivity is low as is potential for domestic grazing. Water yield and big game utilization are generally high.

8. Abies lasiocarpa/Erigeron eximius Habitat Type

GEOGRAPHY. This habitat type is widespread throughout the mountains of southern Colorado and northern New Mexico.

VEGETATION. Pseudotsuga menziesii, Populus tremuloides, and Abies concolor generally occur as seral trees within this type. Vaccinium sp. rarely occurs in the understory, when present, it is minor relative to Erigeron eximius (Figure 9). Lonicera involucrata, Pachistima myrsinites, Ribes montigenum, Rubus parviflorus, Bromopsis ciliata, Arnica cordifolia, Fragaria ovalis, Geranium richardsonii, Oreochyrsum parryi, Ligusticum porteri, Mertensia ciliata, Osmorhiza depauperata, Thalictrum fendleri, and Viola canadensis often typify the characteristically herb-rich understory (Table 2).

Two phases are recognized:

Erigeron eximius phase: Rubus parviflorus poorly-represented or absent

Rubus parviflorus phase: Rubus well-represented

PHYSICAL SETTING. This type occurs on all but the driest south-facing aspects and on all landscape positions (other than ridgetops) at

elevations of 2,800 - 3,200 m. Slopes vary from gentle to very steep. Soils typically have argillic horizons and are Cryoboralfs or Cryoborolls. Occasionally, Cryorthents occur.

Figure 9. Abies lasiocarpa/Erigeron eximius habitat type, San Juan Mountains. This mesic type generally supports the most productive timberlands in the spruce-fir zone. The tree supporting the meter stick is one-meter in diameter. The relatively-dry slope in the background is the Abies lasiocarpa/Vaccinium myrtillus habitat type.

ECOTONES. Absence of Vaccinium sp. suggests the generally warm (for the Abies lasiocarpa series) character of this type. On cooler sites it ecotones to Vaccinium-dominated types. Intergrades to Abies concolor/Erigeron eximius habitat type occur at lower elevations. Often the type occurs in frost pockets within the elevational range of the Abies concolor series. Such frost pockets favor growth of Abies lasiocarpa and Picea engelmannii (Daubenmire and Daubenmire 1968).

COMMENTS. This type has previously been described by Moir and Ludwig

(1979) and by Fitzhugh et al. (1983). The Erigeron phase occurs over a broader range of sites than the Rubus phase. The Rubus phase occurs primarily on steep lower slopes in the San Juan Mountains of Colorado. It is characterisically a wetter habitat. The phase is very similar to the Abies lasiocarpa/Rubus parviflorus habitat type described in the Mogollon Mountains of southern New Mexico by Moir and Ludwig (1979). Both the San Juan and Mogollon Mountains receive high precipitation and this fact may explain the occurrence of Rubus in both areas.

Timber productivity ranges from moderate to high. The presence of Pseudotsuga as an important seral (minor climax in some areas) tree provides flexibility for timber management and opportunities for developing mixed species stands. Slopes in the Rubus phase are generally too steep to be harvested with conventional logging techniques. Many sites in the Erigeron phase occur on gentle topography.

Fire has played a major role in this habitat type and extensive Populus tremuloides stands now occur within it. Understories in these Populus communities are forby. Absence of Vaccinium infers this habitat type rather than one of the Vaccinium habitats of the Abies lasiocarpa series.

Among the habitat types of the Abies lasiocarpa series, overgrazing occurs most frequently in this type. Unlike other habitat types in the series, Poa pratensis sod may develop in response to heavy livestock grazing. Large volumes of browse for elk and deer are produced.

As with most of the Abies lasiocarpa series, high precipitation and snowpack accumulation place watershed management values at high

priority in this habitat type.

Weakly similar habitat types occur throughout the Rocky Mountains. An Abies lasiocarpa/Berberis repens habitat type has been reported in Utah that is identifiable with Abies lasiocarpa/Erigeron eximius habitat type (Pfister 1972). Peet (1981) describes a similar Montane ravine forest community in Rocky Mountain National Park, Colorado. Abies lasiocarpa/Clintonia uniflora and Abies lasiocarpa/Pachistima mrysinites habitat types in the northern Rockies occur in similar environments as described here (Daubenmire and Daubenmire 1968; Pfister et al. 1977; Steele et al. 1981).

Mixed Conifer Forests

Picea pungens Series

GEOGRAPHY. This series is restricted to cold-moist environments throughout the mixed conifer zone. Although widespread geographically, the areal extent of the Picea pungens series is relatively minor since the topo-edaphic features conducive to development of Picea pungens-dominated forests form a minor component of the landscape, e.g. sheltered slopes, frost pockets, perennially moist soils

VEGETATION. As a rule, overstories within the Picea pungens series are highly-mixed. In frost pockets, Abies lasiocarpa and Picea engelmannii occur as minor components of many stands (as in the Picea pungens/Linnaea borealis habitat type) while comparatively warm sites include Pinus ponderosa (as in the Picea pungens/Festuca arizonica habitat type). Pseudotsuga menziesii is typically co-dominant with Picea pungens, while Abies concolor is typically of secondary importance or absent. Populus tremuloides is the major tree species of seral stands.

The generally favorable moisture conditions result in rich species assemblages within this series. Moist sites are forby (dominant species include Erigeron eximius, Artemesia franseriodes, Fragaria americana, Oreochyrum parryi, and Thalictrum fendleri), while drier sites exhibit a rich assortment of graminoids, e.g. Carex foenea, Danthonia parryi, Festuca arizonica, Muhlenbergia montana, and Poa fendleriana.

PHYSICAL SETTING. Examples of this series are most frequently encountered on lower slopes protected from extreme sun and wind.

Elevations range from 2,400 to 2,800 m. Soils are highly-varied taxonomically but are rarely lithic. Cryic soils are encountered in the Picea pungens/Linnaea borealis and occasionally in the Picea pungens/Erigeron eximius habitat type, while all other habitat types in the series are represented by frigid-udic soils.

ECOTONES. Depending on elevation, the moist habitats in the Picea pungens series ecotone to herb-rich habitat types in the Abies lasiocarpa and Abies concolor series. Drier habitats in the series are adjacent to graminoid-dominated habitats in the Abies concolor series.

COMMENTS. Pfister (1972) questioned the successional status of Picea pungens, suggesting that where Abies lasiocarpa or Abies concolor occur in association with P. pungens, P. pungens must be considered seral since it is the least shade tolerant of the three species. In this study, P. pungens was present and reproducing successfully even in those stands containing a complement of Abies sp.. Therefore, no evidence was found suggesting the eventual elimination of P. pungens from stands in the P. pungens series as defined here. This fact, and the finding that P. pungens is indicative of specific enviromental conditions, justify the recognition of a P. pungens climax series.

Heavy disturbance both by grazing and fire is widespread in this series. Careful evaluation of successional Populus tremuloides forests may suggest placement in this series depending on the presence or absence of Picea pungens regeneration.

Management options vary widely within this series. Timber productivity is moderate and Picea engelmannii, Pseudotsuga menziesii, and Pinus ponderosa may all be considered for management. Domestic forage production ranges from low (in the Picea pungens/Linnaea borea-

lis habitat type) to high (in the Picea pungens/Festuca arizonica habitat type), and big game forage is good throughout the series. Snow accumulations are often significant and serve to heighten watershed opportunities within the series. Finally, scenic attributes are important since the characteristic lower slope positions of the series places it in view of many roads, trails, and campgrounds.

9. Picea pungens/Linnaea borealis Habitat Type

GEOGRAPHY. This is a rare habitat type and was only found in the northern Sangre de Cristo Range in New Mexico and in the San Juan Mountains of Colorado.

VEGETATION. Picea pungens and Pseudotsuga menziesii co-dominate the overstory. Pinus flexilis and Abies concolor are of common occurrence. The successional status of Abies concolor in this habitat type is uncertain. Abies lasiocarpa and Picea engelmannii occur as minor components of some stands in frost pockets.

Favorable moisture conditions result in a rich assemblage of shrub and herb species within this type (Figure 10). In addition to abundant Linnaea; Pachistima myrsinites, Rubus parviflorus, and Carex foenea characterize the understory (Table 3).

PHYSICAL SETTING. Examples of this type are most commonly encountered on steep, northerly lower slopes protected from extreme sun and wind between elevations of 2,500 and 2,800 m. Soils include Cryoborolls and Cryochrepts.

ECOTONES. Ecotones with such species-rich habitat types as Abies lasiocarpa/Erigeron eximius, Abies lasiocarpa/Linnaea borealis, or

Table 3. Species frequencies (FRQ) and average tree density or shrub-herb cover (CVR) for northern New Mexico-southern Colorado mixed-conifer habitat types.

HTS:	9		10		11		12		13		14	
NO. PLOTS:	(8)		(13)		(4)		(4)		(9)		(13)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -												
ABIES CONCOLOR - YNG REGEN	63	10	62	7	50	1	75	5	22	2	100	52
ABIES CONCOLOR - ADV REGEN	63	4	62	3	25	<1	50	2	11	3	100	9
ABIES CONCOLOR - MATURE	13	<1	46	1	25	<1			22	<1	77	3
ABIES LASIOCARPA - YNG REGEN	50	8	15	<1			25	<1			8	<1
ABIES LASIOCARPA - ADV REGEN	38	1	15	<1							38	<1
ABIES LASIOCARPA - MATURE	13	<1										
JUNIPERUS SCOPULORUM-YNG REGEN			8	<1								
JUNIPERUS SCOPULORUM-ADV REGEN												
JUNIPERUS SCOPULORUM- MATURE												
PICEA ENGELMANNII - YNG REGEN	50	4	15	<1							23	<1
PICEA ENGELMANNII - ADV REGEN	50	2	23	<1							23	<1
PICEA ENGELMANNII - MATURE	25	<1									8	<1
PICEA PUNGENS - YNG REGEN	100	22	92	9	100	24	100	14	100	11	15	2
PICEA PUNGENS - ADV REGEN	100	12	100	8	100	9	100	7	100	12	15	<1
PICEA PUNGENS - MATURE	88	4	77	3	100	9	50	3	89	3	8	<1
PINUS ARISTATA - YNG REGEN												
PINUS ARISTATA - ADV REGEN												
PINUS ARISTATA - MATURE												
PINUS FLEXILIS - YNG REGEN	63	2	62	4			50	2	44	<1	15	<1
PINUS FLEXILIS - ADV REGEN	13	<1	31	<1	50	<1	50	<1	11	<1	8	<1
PINUS FLEXILIS - MATURE	13	<1	8	<1					11	<1		
PINUS PONDEROSA - YNG REGEN	13	<1					50	11	33	1	8	<1
PINUS PONDEROSA - ADV REGEN			8	<1	50	5	50	2	56	5	23	<1
PINUS PONDEROSA - MATURE	13	<1	8	<1	75	3	50	2	56	1	38	<1
POPULUS TREMULOIDES-YNG REGEN	63	2	62	2	50	1	100	44	56	3	54	6
POPULUS TREMULOIDES-ADV REGEN	25	<1	46	2			75	2	67	2	67	2
POPULUS TREMULOIDES-MATURE	13	<1	15	<1					11	<1	31	<1
PSEUDOTSUGA MENZIESII-YNG REG	100	30	85	13	100	20	100	21	89	3	92	11
PSEUDOTSUGA MENZIESII-ADV REG	100	7	85	7	100	3	100	14	78	1	92	6
PSEUDOTSUGA MENZIESII- MATURE	75	5	85	5	25	1	75	3	33	<1	85	5
QUERCUS GAMBELII - YNG REGEN											8	<1
QUERCUS GAMBELII - ADV REGEN									11	<1		
QUERCUS GAMBELII - MATURE												
- - S H R U B S - -												
ACER GLABRUM	50	<1	31	<1							62	7
AMELANCHIER ALNIFOLIA	38	<1	15	<1			50	<1	11	<1	62	2
ARCTOSTAPHYLOS UVA-URSI	50	<1	23	<1	25	<1	100	24	44	<1	31	6
CERCOCARPUS MONTANUS												
CLEMATIS COLUMBIANA	88	<1	46	<1			25	<1	11	<1	38	<1
HOLODISCUS DUMOSUS			8	<1								
JAMESIA AMERICANA			15	<1							15	<1
JUNIPERUS COMMUNIS	88	2	62	2	100	2	75	6	78	<1	62	1
LINNAEA BOREALIS	100	24	8	<1							23	<1
MAHONIA REPENS	25	<1	31	4			50	1	11	<1	92	4
ORTHILIA SECUNDA	100	<1	54	<1	25	<1	25	<1			54	<1
PACHISTIMA MYRSINITES	100	9	77	2			50	<1	11	<1	100	6

Table 3. (continued)

HTS:	9		10		11		12		13		14	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
PHYSOCARPUS MONOGYNUS	8	2										
PRUNUS VIRGINIANA	8	<1			25	<1			11	<1	15	<1
QUERCUS GAMBELII	25	<1	15	<1	25	<1	50	<1	44	<1	8	<1
RIBES CEREUM	13	<1	15	<1								
RIBES INERME	13	<1	23	<1	50	<1			11	<1		
ROSA SPP.	88	2	62	1			100	2	44	<1	77	<1
RUBUS PARVIFLORUS	63	5	31	<1							62	5
SWIDA SERICEA	25	<1	23	<1			25	<1			8	<1
SYMPHORICARPUS OREOPHILUS	75	<1	54	2			25	<1	22	<1	62	1
VACCINIUM SP.	63	3	15	<1							100	22
- - G R A M I N O I D S - -												
BROMOPSIS CILIATA	88	<1	77	<1	75	<1	100	<1	67	<1	92	<1
CAREX FOENEA	100	14	54	3	100	51			44	2		
CAREX GEYERI									11	<1		
CAREX ROSSII	25	<1	54	<1	25	<1	75	<1	44	<1	62	<1
DANTHONIA PARRYI					50	2	50	<1	67	5		
FESTUCA ARIZONICA	13	<1	31	<1	25	<1	50	2	100	11		
KOELERIA MACRANTHA	13	<1	38	<1			100	<1	100	2	15	<1
MUHLENBERGIA MONTANA			23	<1			75	<1	67	3		
ORYZOPSIS ASPERIFOLIA	50	2	23	<1	25	<1	50	<1			54	<1
POA FENDLERIANA	13	<1	46	<1	75	<1	50	<1	100	2	23	<1
SITANION HYSTRIX			8	<1	50	<1	25	<1	78	<1	8	<1
TRISETUM SPICATUM S. MONTANUM	88	<1	23	<1	75	2					15	<1
- - F O R B S - -												
ACHILLEA MILLEFOLIUM	38	<1	23	<1	100	<1	75	<1	89	<1	23	1
ANTENNARIA ROSEA	25	<1	38	<1	100	1	75	<1	100	<1	15	<1
ARNICA CORDIFOLIA	25	1			25	<1			11	<1	38	1
ARTEMISIA FRANSERIOIDES	63	1	46	1			25	<1	22	<1	69	1
ARTEMISIA LUDOVICIANA			8	<1	50	<1	50	<1	56	<1		
ERIGERON EXIMIUS	100	3	77	4	25	<1	25	<1			69	2
ERIGERON FORMOSISSIMUS					75	1	50	<1	56	2		
ERIGERON SUBTRINERVIS			8	<1			50	<1	56	<1		
FRAGARIA AMERICANA	63	2	54	2	100	6	50	2	56	<1	15	<1
FRAGARIA OVALIS	88	3	69	<1	100	14	100	6	89	1	62	1
GALIUM TRIFLORUM	38	<1			50	3			11	<1	8	<1
GERANIUM CAESPITOSUM			8	<1			25	<1	44	<1	15	<1
GERANIUM RICHARSONII	38	2	38	<1	100	4	50	<1			46	<1
LATHYRUS SP.	63	2	54	<1	100	<1	75	<1	56	2	69	4
LIGUSTICUM PORTERI	13	<1	8	<1					11	<1	15	<1
OREOCHRYSUM PARRYI	63	<1	77	2	75	<1			44	<1	69	<1
OSMORHIZA DEPAUPERATA	38	<1	31	<1	75	<1			11	<1	54	<1
POTENTILLA HIPPIANA			15	<1	100	1	75	<1	100	1		
PSEUDOCYMOPTERIS MONTANUS	50	<1	23	<1	100	<1	75	<1	67	<1	54	<1
SMILACINA RACEMOSA	88	<1	38	<1			25	<1	11	<1	62	<1
SMILACINA STELLATA	25	<1	54	1	25	<1	100	<1	33	<1	38	<1
THALICTRUM FENDLERI	88	3	46	3	25	<1			67	<1	15	<1
THERMOPSIS SP.	13	<1			25	<1			33	<1	38	1
VICIA AMERICANA	13	<1	46	<1	50	<1	75	<1	67	<1	23	<1
VIOLA CANADENSIS	63	<1	23	<1	100	<1	50	<1			46	<1

Table 3. (continued)

HTS:	15		16		17		18		19		20	
NO. PLOTS:	(18)		(22)		(26)		(7)		(10)		(13)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -												
ABIES CONCOLOR - YNG REGEN	89	17	100	27	85	15	86	22	90	10	92	22
ABIES CONCOLOR - ADV REGEN	89	6	95	11	85	5	100	5	90	4	100	10
ABIES CONCOLOR - MATURE	67	4	68	3	54	2	57	1	60	1	46	2
ABIES LASIOCARPA - YNG REGEN			14	<1								
ABIES LASIOCARPA - ADV REGEN	11	<1										
ABIES LASIOCARPA - MATURE												
JUNIPERUS SCOPULORUM-YNG REGEN					8	<1			10	<1	8	<1
JUNIPERUS SCOPULORUM-ADV REGEN					8	<1						
JUNIPERUS SCOPULORUM- MATURE												
PICEA ENGELMANNII - YNG REGEN	11	<1	18	<1	8	<1						
PICEA ENGELMANNII - ADV REGEN	17	<1	18	<1	12	<1						
PICEA ENGELMANNII - MATURE												
PICEA PUNGENS - YNG REGEN	33	<1	5	<1	15	<1					23	<1
PICEA PUNGENS - ADV REGEN	39	<1	9	<1	12	<1					15	<1
PICEA PUNGENS - MATURE	22	<1			4	<1						
PINUS ARISTATA - YNG REGEN					4	<1						
PINUS ARISTATA - ADV REGEN					4	<1						
PINUS ARISTATA - MATURE					4	<1						
PINUS FLEXILIS - YNG REGEN	17	<1	41	2	46	2	43	2	40	4	38	<1
PINUS FLEXILIS - ADV REGEN	28	<1	9	<1	38	1	43	1	40	2	31	<1
PINUS FLEXILIS - MATURE	6	<1	14	<1	19	<1			20	<1	31	<1
PINUS PONDEROSA - YNG REGEN			9	<1	15	<1	57	4	40	3	38	<1
PINUS PONDEROSA - ADV REGEN	17	<1			38	2	86	7	50	3	69	2
PINUS PONDEROSA - MATURE	6	<1	14	<1	38	1	86	4	50	2	69	2
POPULUS TREMULOIDES-YNG REGEN	39	4	41	2	38	2			30	3	23	1
POPULUS TREMULOIDES-ADV REGEN	67	3	27	1	27	<1	29	1	20	<1	15	1
POPULUS TREMULOIDES-MATURE	22	<1	5	<1							8	<1
PSEUDOTSUGA MENZIESII-YNG REG	89	11	86	13	92	13	100	11	100	14	77	7
PSEUDOTSUGA MENZIESII-ADV REG	94	8	91	7	96	12	71	6	80	5	77	4
PSEUDOTSUGA MENZIESII- MATURE	94	6	77	3	88	6	71	4	80	2	62	2
QUERCUS GAMBELII - YNG REGEN			14	1			14	2	20	12	38	2
QUERCUS GAMBELII - ADV REGEN											8	<1
QUERCUS GAMBELII - MATURE												
- - S H R U B S - -												
ACER GLABRUM	44	1	100	14	27	<1	14	<1			15	<1
AMELANCHIER ALNIFOLIA	17	<1	77	5	19	<1	14	<1	10	<1	15	<1
ARCTOSTAPHYLOS UVA-URSI	11	<1	9	<1	31	<1	100	24	30	1	8	<1
CERCOCARPUS MONTANUS					8	<1	14	<1			15	<1
CLEMATIS COLUMBIANA	56	<1	73	2	54	<1	29	<1	60	<1	15	<1
HOLODISCUS DUMOSUS			14	<1	19	<1			20	<1	8	<1
JAMESIA AMERICANA	28	1	18	1	15	<1	14	<1			23	3
JUNIPERUS COMMUNIS	28	<1	27	<1	54	2	57	1	40	<1	31	<1
LINNAEA BOREALIS			9	<1								
MAHONIA REPENS	61	<1	77	4	58	2	43	<1	20	<1	92	1
ORTHILIA SECUNDA	39	<1	55	<1	23	<1						
PACHISTIMA MYRSINITES	61	1	91	4	54	<1	71	3	10	<1	46	<1

Table 3. (continued)

HTS:	15		16		17		18		19		20	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
PHYSOCARPUS MONOGYNUS	11	<1	18	4	12	2			10	<1	8	<1
PRUNUS VIRGINIANA	17	<1	36	<1	19	<1					38	<1
QUERCUS GAMBELII	28	<1	55	2	31	<1	43	<1	20	1	100	22
RIBES CEREUM					12	<1	14	<1	40	<1	8	<1
RIBES INERME	11	<1	5	<1	4	<1			10	<1	8	<1
ROSA SPP.	72	1	82	<1	81	<1	57	<1	50	<1	69	1
RUBUS PARVIFLORUS	78	<1	45	1	4	<1						
SWIDA SERICEA	6	<1	18	2								
SYMPHORICARPUS OREOPHILUS	56	2	82	8	77	3	57	<1	30	<1	54	5
VACCINIUM SP.			14	<1	15	<1						
--GRAMINOIDS--												
BROMOPSIS CILIATA	100	3	95	<1	50	<1	57	<1	40	<1	77	<1
CAREX FOENEA	50	9	14	<1	15	<1	14	<1	10	<1	23	<1
CAREX GEYERI			23	2							8	<1
CAREX ROSSII	61	<1	64	<1	81	<1	57	<1	90	<1	85	2
DANTHONIA PARRYI	6	<1					14	<1	20	1		
FESTUCA ARIZONICA	6	<1	5	<1	19	<1	43	<1	100	8		
KOELERIA MACRANTHA	33	<1	23	<1	65	<1	100	<1	70	<1	54	<1
MUHLENBERGIA MONTANA					19	<1	71	<1	60	2	23	<1
ORYZOPSIS ASPERIFOLIA	17	<1	18	<1	8	<1					8	<1
POA FENDLERIANA	22	<1	50	<1	69	<1	71	<1	90	1	77	<1
SITANION HYSTRIX	17	<1	9	<1	19	<1	43	<1	40	<1	31	<1
TRISETUM SPICATUM S. MONTANUM	67	<1	41	<1	15	<1						
--FORBS--												
ACHILLEA MILLEFOLIUM	61	<1	14	<1	23	<1	29	<1	41	<1	46	2
ANTENNARIA ROSEA	22	<1	5	<1	35	<1	43	<1	30	<1		
ARNICA CORDIFOLIA	6	<1	27	2	15	<1					8	<1
ARTEMISIA FRANSERIOIDES	67	4	55	1	50	<1			20	<1	8	<1
ARTEMISIA LUDOVICIANA					15	<1	14	<1	30	<1	31	<1
ERIGERON EXIMIUS	83	22	59	2	23	<1			30	<1	8	<1
ERIGERON FORMOSISSIMUS					4	<1	14	<1	50	<1		
ERIGERON SUBTRINERVIS	11	<1			12	<1	29	<1			23	<1
FRAGARIA AMERICANA	39	<1	50	<1	46	<1	14	<1	40	<1	23	<1
FRAGARIA OVALIS	89	2	50	<1	35	<1	71	<1	50	<1	54	1
GALIUM TRIFLORUM	28	1	14	<1								
GERANIUM CAESPITOSUM	6	<1	5	<1	4	<1			10	<1	31	<1
GERANIUM RICHARSONII	67	2	32	<1	4	<1					8	<1
LATHYRUS SP.	89	12	68	3	23	<1	14	<1	50	3	46	<1
LIGUSTICUM PORTERI			23	1								
OREOCHRYSUM PARRYI	78	4	50	<1	42	<1	43	<1	10	<1	46	<1
OSMORHIZA DEPAUPERATA	50	<1	36	<1							15	<1
POTENTILLA HIPPIANA					8	<1			30	<1		
PSEUDOCYMOPTERIS MONTANUS	61	<1	23	<1	19	<1	29	<1	20	<1	38	<1
SMILACINA RACEMOSA	22	<1	59	<1	19	<1					15	<1
SMILACINA STELLATA	39	1	23	<1	19	<1	14	<1	20	<1	8	<1
THALICTRUM FENDLERI	56	2	59	<1	19	<1			20	<1	62	<1
THERMOPSIS SP.	17	4	9	<1			43	<1	20	<1		
VICIA AMERICANA	44	<1	18	<1	15	<1	14	<1	30	<1	31	<1
VIOLA CANADENSIS	61	<1	55	<1	4	<1					8	<1

Table 3. (continued)

HTS:	21		22A		22B		23A		23B	
NO. PLOTS:	(4)		(4)		(7)		(12)		(11)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -										
ABIES CONCOLOR - YNG REGEN							25	<1	9	<1
ABIES CONCOLOR - ADV REGEN	25	<1			14	<1	8	<1		
ABIES CONCOLOR - MATURE										
ABIES LASIOCARPA - YNG REGEN	25	<1								
ABIES LASIOCARPA - ADV REGEN										
ABIES LASIOCARPA - MATURE										
JUNIPERUS SCOPULORUM-YNG REGEN							42	2	45	3
JUNIPERUS SCOPULORUM-ADV REGEN							17	<1	55	1
JUNIPERUS SCOPULORUM- MATURE									18	<1
PICEA ENGELMANNII - YNG REGEN	25	2								
PICEA ENGELMANNII - ADV REGEN	75	6								
PICEA ENGELMANNII - MATURE	25	<1								
PICEA PUNGENS - YNG REGEN					29	<1	8	<1		
PICEA PUNGENS - ADV REGEN									9	<1
PICEA PUNGENS - MATURE					14	<1				
PINUS ARISTATA - YNG REGEN			100	3						
PINUS ARISTATA - ADV REGEN			100	6						
PINUS ARISTATA - MATURE			100	7						
PINUS FLEXILIS - YNG REGEN	100	8			57	1	17	<1	9	<1
PINUS FLEXILIS - ADV REGEN	100	13			14	<1			18	<1
PINUS FLEXILIS - MATURE	100	9	25	<1						
PINUS PONDEROSA - YNG REGEN					29	<1	50	3	64	1
PINUS PONDEROSA - ADV REGEN	25	<1			43	<1	83	3	82	5
PINUS PONDEROSA - MATURE					71	2	58	3	91	2
POPULUS TREMULOIDES-YNG REGEN	25	<1	25	2	43	7				
POPULUS TREMULOIDES-ADV REGEN	50	<1								
POPULUS TREMULOIDES-MATURE										
PSEUDOTSUGA MENZIESII-YNG REG	75	3	50	2	100	7	92	14	100	14
PSEUDOTSUGA MENZIESII-ADV REG	75	2	50	2	100	4	100	7	100	5
PSEUDOTSUGA MENZIESII- MATURE	100	3	75	2	100	2	83	2	100	3
QUERCUS GAMBELII - YNG REGEN							67	17	91	38
QUERCUS GAMBELII - ADV REGEN							42	2	36	2
QUERCUS GAMBELII - MATURE										
- - S H R U B S - -										
ACER GLABRUM							8	<1		
AMELANCHIER ALNIFOLIA					29	<1	25	<1	91	4
ARCTOSTAPHYLOS UVA-URSI	100	25			71	3	17	<1		
CERCOCARPUS MONTANUS					29	<1	58	2	36	<1
CLEMATIS COLUMBIANA			75	<1	14	<1	50	<1	9	<1
HOLODISCUS DUMOSUS	25	<1	25	<1	14	<1	8	<1		
JAMESIA AMERICANA	75	<1								
JUNIPERUS COMMUNIS	100	4	25	<1	71	1	17	<1		
LINNAEA BOREALIS										
MAHONIA REPENS					43	1	25	<2	91	1
ORTHILIA SECUNDA										
PACHISTIMA MYRSINITES	25	<1	25	<1	14	<1	25	<1	73	1

Table 3. (continued)

HTS:	21		22A		22B		23A		23B	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
PHYSOCARPUS MONOGYNUS			25	<1			42	<1		
PRUNUS VIRGINIANA					29	<1	33	<1	9	<1
QUERCUS GAMBELII							100	23	100	35
RIBES CEREUM			50	2	14	<1	25	<1	9	<1
RIBES INERME					14	<1				
ROSA SPP.	75	<1			71	<1	42	<1	73	3
RUBUS PARVIFLORUS										
SWIDA SERICEA							8	<1		
SYMPHORICARPUS OREOPHILUS	25	<1	25	1	43	<1	67	3	73	4
VACCINIUM SP.										
--GRAMINOIDS--										
BROMOPSIS CILIATA	25	<1			43	<1	50	<1	45	<1
CAREX FOENEA							8	<1	18	<1
CAREX GEYERI					14	<1	8	<1	45	2
CAREX ROSSII	75	<1	50	<1	86	<1	17	<1	36	<1
DANTHONIA PARRYI	25	<1	50	<1	43	<1	25	4		
FESTUCA ARIZONICA	25	<1	100	14	100	11	100	5		
KOELERIA MACRANTHA	75	<1	100	3	100	<1	100	<1	36	<1
MUHLENBERGIA MONTANA			50	5	57	2	75	3		
ORYZOPSIS ASPERIFOLIA										
POA FENDLERIANA	25	<1	75	2	100	4	92	1	100	2
SITANION HYSTRIX			75	<1	86	<1	83	<1	55	<1
TRISETUM SPICATUM S. MONTANUM										
--FORBS--										
ACHILLEA MILLEFOLIUM			25	<1	14	<1	42	<1	18	<1
ANTENNARIA ROSEA	50	<1			86	<1	42	<1	36	<1
ARNICA CORDIFOLIA										
ARTEMISIA FRANSERIOIDES	25	<1	75	<1	14	<1	8	<1		
ARTEMISIA LUDOVICIANA			25	<1	43	<1	67	<1	36	<1
ERIGERON EXIMIUS	8	<1			25	2				
ERIGERON FORMOSISSIMUS							8	<1	9	<1
ERIGERON SUBTRINERVIS					43	<1	50	<1	18	<1
FRAGARIA AMERICANA			25	<1	14	<1	42	<1	9	<1
FRAGARIA OVALIS	25	<1			29	<1	8	<1	9	<1
GALIUM TRIFLORUM					14	<1				
GERANIUM CAESPITOSUM	50	<1	25	<1	71	<1	17	<1	18	<1
GERANIUM RICHARSONII										
LATHYRUS SP.			25	<1	29	<1	42	1	9	<1
LIGUSTICUM PORTERI										
OREOCHRYSUM PARRYI	50	<1	25	<1	14	<1	17	<1		
OSMORHIZA DEPAUPERATA										
POTENTILLA HIPPIANA			25	<1	57	<1	50	<1	9	<1
PSEUDOCYMOPTERIS MONTANUS					14	<1	50	<1		
SMILACINA RACEMOSA							8	<1	36	<1
SMILACINA STELLATA			25	<1	43	<1	8	<1	27	<1
THALICTRUM FENDLERI					14	<1	50	1	18	<1
THERMOPSIS SP.					14	<1	8	3		
VICIA AMERICANA			25	<1	29	<1	42	<1	45	<1
VIOLA CANADENSIS										

* HT. 9 =PICEA PUNGENS/LINNAEA BOREALIS HT
HT. 10 =PICEA PUNGENS/ERIGERON EXIMIUS HT
HT. 11 =PICEA PUNGENS/CAREX FOENEA HT
HT. 12 =PICEA PUNGENS/ARCTOSTAPHYLOS UVA-URSI HT
HT. 13 =PICEA PUNGENS/FESTUCA ARIZONICA HT
HT. 14 =ABIES CONCOLOR/VACCINIUM MYRTILLUS HT
HT. 15 =ABIES CONCOLOR/ERIGERON EXIMIUS HT
HT. 16 =ABIES CONCOLOR/ACER GLABRUM HT
HT. 17 =ABIES CONCOLOR/SPARSE HT
HT. 18 =ABIES CONCOLOR/ARCTOSTAPHYLOS UVA-URSI HT
HT. 19 =ABIES CONCOLOR/FESTUCA ARIZONICA HT
HT. 20 =ABIES CONCOLOR/QUERCUS GAMBELII HT
HT. 21 =PSEUDOTSUGA MENZIESII/ARCTOSTAPHYLOS UVA-URSI HT
HT. 22A =PSEUDOTSUGA MENZIESIIFESTUCA ARIZONICA HT, PINUS ARISTATA PH
HT. 22B =PSEUDOTSUGA MENZIESII/FESTUCA ARIZONICA HT, PSEUDOTSUGA MENZIESII PH
HT. 23A =PSEUDOTSUGA MENZIESII/QUERCUS GAMBELII HT, FESTUCA ARIZONICA PH.
HT. 23B =PSEUDOTSUGA MENZIESII/QUERCUS GAMBELII HT, QUERCUS GAMBELII PH.

Abies lasiocarpa/Rubus parviflorus. Rubus parviflorus phase are common.

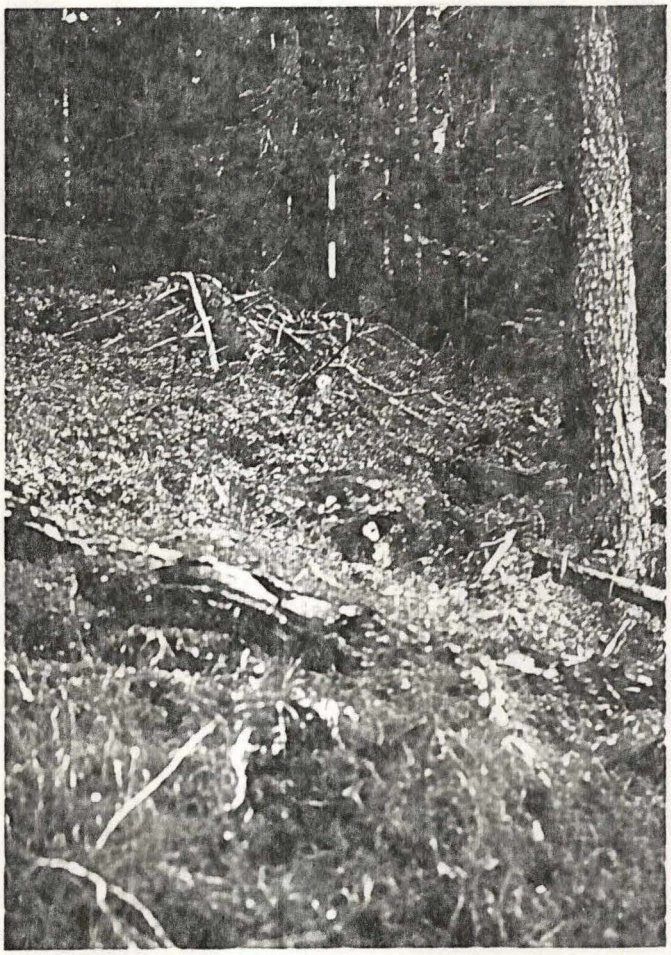

Figure 10. Picea pungens/Linnaea borealis habitat type, San Juan Mountains. As with other Linnaea-dominated understories moss cover is high (here 60 percent). This type characteristically occurs on cold-moist lower slopes.

COMMENTS. This is the most mesic of the Picea pungens habitat types. Previously, this type was treated as a phase of a Picea pungens-Pseudotsuga menziesii habitat type described by Moir and Ludwig (1979). In the northern Rockies, the Abies grandis/Linnaea borealis habitat type is weakly-related to this type, outside the range of Picea pungens (Pfister et al. 1977; Steele et al. 1981).

Forage production is poor for domestic stock but good for deer and elk. Heavy winter snow accumulations limit access at that time.

10. Picea pungens/Erigeron eximius Habitat Type

GEOGRAPHY. This type may be expected in any mountain range within the study area.

VEGETATION. Overstories are similar to those found in Picea pungens/Linnaea borealis habitat type. Abies lasiocarpa and Picea engelmannii are less frequent associates however, as the sites are generally warmer than the Linnaea type.

Typically, understories are highly variable both in composition and total cover (Table 3). The moist extreme is characterized by high forb cover in which Erigeron eximius is diagnostic (Figure 11). In drier situations no diagnostic species occur with consistantly high cover. Graminoid cover is characteristically low throughout the type. Further investigation may yield data in support of distinguishing phases within this varied habitat type.

PHYSICAL SETTING. This type occurs at elevations ranging from 2,500 to 2,800 meters on moderate to steep lower slopes. Any slope exposure may be expected within this type. Soils vary from Typic Udorthents to Eutric Glossoboralfs.

ECOTONES. Lower elevation ecotones are with Abies concolor/Erigeron eximius and higher elevations are with Abies lasiocarpa/Erigeron eximius habitat type.

Figure 11. Picea pungens/Erigeron eximius habitat type, San Juan Mountains. This type is highly-varied in understory species composition. Characteristically, mesic herbs occur such as Erigeron eximius, Carex foenea, Geranium richardsonii, and Thalictrum fendleri.

COMMENTS. Heavy disturbance both by grazing and by fire make plot selection difficult in this type. The type is widespread, however, and careful evaluation of successional forests (largely Populus tremuloides forb-rich communities) within the physical range of this type is necessary in ascertaining the correct habitat type. Particular attention should be paid to the presence or absence of Picea pungens regeneration.

The type is similar to the Picea pungens/Fragaria ovalis habitat type, Erigeron eximius phase of southern New Mexico and Arizona described by Fitzugh et. al. (1983). Similarly, affinities occur with Picea pungens-Picea engelmannii/Erigeron superbus habitat type described in the White Mountains of Arizona (Moir and Ludwig 1979).

The lower slope position of this type places it adjacent to many roads, trails, and campgrounds. Thus, the habitat type has important scenic qualities for the tourist industry.

11. Picea pungens/Carex foenea Habitat Type

GEOGRAPHY. Samples of this minor habitat type were found only in the Jemez Mountains of New Mexico.

VEGETATION. Overstories typically exhibit codominance of Picea pungens and Pseudotsuga menziesii, with Pinus ponderosa (seral) important in some stands. Abies concolor is generally absent or minor. Understories are characterized by abundant Carex foenea and often high coverage of Fragaria sp. and Geranium richardsonii (Figure 12).

PHYSICAL SETTING. This habitat type occurs on northerly sloping canyon sideslopes at elevations ranging from 2,600 to 2,750 meters. Slope steepness typically is slight to moderate. Dominant soils are Typic Dystrandepts.

ECOTONES. Lower ecotones often occur with Picea pungens/Festuca arizonica habitat type and upper ecotones with Picea pungens/Erigeron eximius or Abies concolor/Acer glabrum habitat type. The type often borders grassy meadows.

COMMENTS. As with other habitats that support high cover of palatable graminoids, this type is often used by grazing animals. The generally moderate terrain and often close proximity to water further promote the grazing suitability of the type. Many stands of this habitat type are within summer grazing allotments. The type is relatively minor in terms of aerial extent and therefore is of little

consequence for management. Moir and Ludwig (1979) have previously described this type. The type is basically synonymous with Picea pungens/Fragaria ovalis habitat type, Carex foenea phase of Fitzhugh et al. (1983).

Pseudotsuga menziesii and Pinus ponderosa are important commercial trees occurring within this type. However, growth is moderate at best.

Figure 12. Picea pungens/Carex foenea habitat type, Jemez Mountains. This well-developed understory is dominated by graminoids. Common species in this stand are Carex foenea (50 percent cover), Trisetum spicatum ssp. montanum, Festuca sororia, and Danthonia intermedia.

12. Picea pungens/Arctostapylos uva-ursi Habitat Type

GEOGRAPHY. Picea pungens/Arctostaphylos uva-ursi is a minor habitat type primarily occurring in the San Juan Mountains.

VEGETATION. Picea pungens, Pseudotsuga menziesii, and Pinus ponderosa frequently co-dominate in the overstory. Occasionally, Abies concolor

and Pinus flexilis are also important. Arctostaphylos uva-ursi is the characteristic understory dominant and Juniperus communis, Festuca arizonica, and Fragaria ovalis are frequently important (Figure 13).

Figure 13. Picea pungens/Arctostaphylos uva-ursi habitat type, San Juan Mountains. Understories are typically sparse in this type. Only Arctostaphylos uva-ursi and Juniperus communis are well represented in this stand.

PHYSICAL SETTING. The type occurs on warm-dry south slope environments at elevations ranging from 2,400 to 2,800 m. Seldom does the type occur in midslope positions; instead ridges and lower slopes are the characteristic landforms associated with Picea pungens/Arctostaphylos uva-ursi habitat type. Slopes are moderately steep.

ECOTONES. Warmer sites merge to Picea pungens/Festuca arizonica or Abies concolor/Arctostaphylos uva-ursi habitat type, while cooler site ecotones are with Picea pungens/Carex foenea habitat type.

COMMENTS. This type was previously described by Moir and Ludwig (1979) as the Arctostaphylos phase of their Picea pungens-Pseudotsuga menziesii habitat type. Within the Picea pungens series, only Picea pungens/Festuca arizonica habitat type is characteristically found in warmer-drier situations.

13. Picea pungens/Festuca arizonica Habitat Type

GEOGRAPHY. This type occurs primarily in the Jemez Mountains of New Mexico and in the San Juan Mountains of Colorado.

VEGETATION. Overstories are similar to those described for Picea pungens/Arctostaphylos uva-ursi habitat type. Understories are characterized by high cover of a rich assortment of graminoids (Figure 14) Festuca arizonica, Carex foenea, Danthonia parryi, Koeleria macrantha, Muhlenbergia montana, Poa fendleriana, and Sitanion hystrix are in the species lists of most plots. Important forbs include Erigeron formosissimus, Fragaria sp., Latharus sp., and Potentilla hippiana.

PHYSICAL SETTING. In contrast to the Picea pungens/Carex foenea habitat type which occurs on northerly slopes this type is generally southwesterly in aspect and thus represents warmer situations. Elevations vary from 2,500 to 2,800 meters and slopes are moderate to steep. Soil subgroups are highly varied and include Udic Argiborolls and Haploborolls, Lithic Haploborolls, Eutric Glossoboralfs, Typic Dystochrepts, and Andeptic Udorthents.

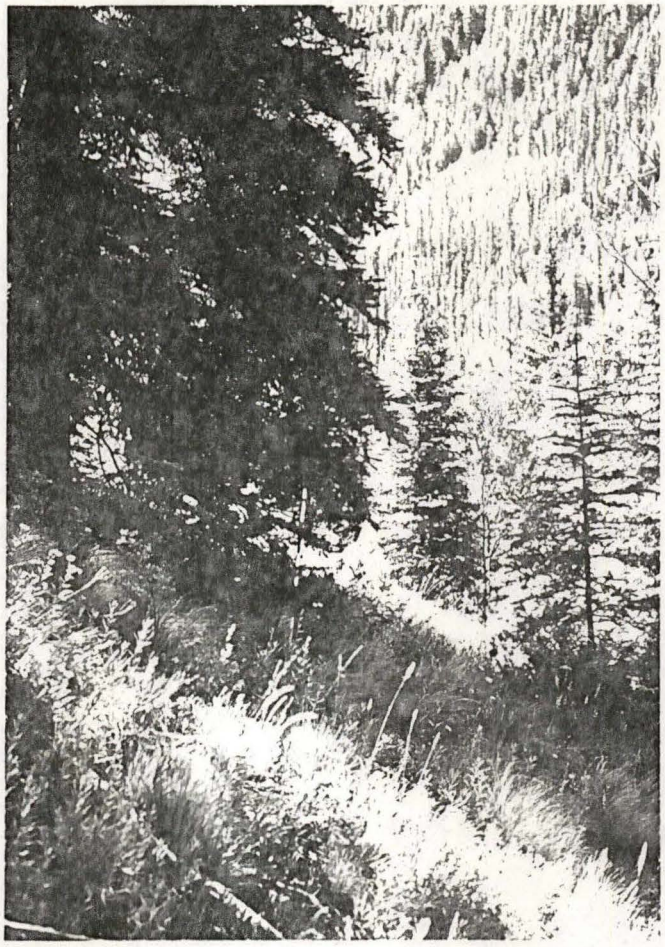

Figure 14. Picea pungens/Festuca arizonica habitat type, San Juan Mountains. This type is the driest in the Picea pungens series. As shown here, stands are open allowing the shade intolerant grass Festuca arizonica to dominate the understory.

ECOTONES. Abies concolor/Festuca arizonica habitat type is encountered in slightly drier situations and Abies concolor/Carex foenea habitat type in more mesic areas.

COMMENTS. Picea pungens/Fragaria ovalis habitat type, Festuca arizonica phase reported in southern Arizona and New Mexico is essentially the same type described here (Fitzhugh et al. 1983). This represents the warmest-driest of Picea pungens-dominated forests. It is

moderately extensive particularly when considered in combination with the closely related Abies concolor/Festuca arizonica habitat type. The high palatability of Festuca arizonica make forage management important in this type.

Abies concolor Series

GEOGRAPHY. The Abies concolor series occurs at mid-elevations and is the most widespread mixed conifer series. Only the Dolores Mesa country of the far-western San Juan Mountains of Colorado lack a representation of this series (since the area is outside the range of Abies concolor).

VEGETATION. Overstories are highly-mixed, with seven coniferous species occurring together in some stands, i.e., Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus flexilis, Pinus ponderosa, and Pseudotsuga menziesii. However, the presence and relative proportion of these species is dependent on moisture-temperature relationships. In all cases, successful reproduction of Abies concolor relative to other coniferous species is diagnostic of this series. Early seral communities are dominated by Populus tremuloides in mesic situations, and by Quercus gambelii on comparitively xeric sites.

Understories are also highly-variable. Among the diagnostic species, the coldest environments exhibit Vaccinium sp., while warm environments support abundant Festuca arizonica; dry sites feature Quercus gambelii, and moist sites favor Erigeron eximius. Shrub-rich, herb-rich, graminoid-rich, and stands having depauperate understories (i.e., Abies concolor/SPARSE habitat type) are all represented in this series. Understories may resemble those of the Pseudotsuga menziesii series on dry sites or the Abies lasiocarpa series on cold

sites.

PHYSICAL SETTING. Elevations range from 2,400 to 3,100 m. Settings vary from cold-moist sites having cryic soils to warm-dry sites having frigid-udic soils.

ECOTONES. The Abies concolor series exhibits the most complex ecotonal relationships of any forested series in the study area (Layser and Schubert 1979). Upper elevations grade to the Abies lasiocarpa series, while cool-moist sites at the same elevation feature the Picea pungens series. Lower elevations support either the Pseudotsuga menziesii or Pinus ponderosa series (Pinus ponderosa occurring on the most xeric sites).

COMMENTS. Management options are most highly varied within the Abies concolor series. Timber productivity may be high for Pseudotsuga menziesii in the Abies concolor/Erigeron eximius habitat type. Grazing opportunities for domestic stock are maximized in the Abies concolor/Festuca arizonica habitat type. Big game utilization may be exceptionally high in the Abies concolor/Acer glabrum habitat type. Heavy snow accumulation will produce high water yields in the Abies concolor/Vaccinium habitat type. Varied topographical and biological conditions within the series add to the aesthetic attributes.

Basically, the Abies concolor series is ecologically similar to the Abies grandis series of the northern Rocky Mountains as described by Pfister et al. (1977) and Steele et al. (1981). Both the A. concolor and the A. grandis series lie between the drier Pseudotsuga menziesii series and the cooler Abies lasiocarpa series.

Fire is a major influence in maintaining many habitat types in

this series. Abies concolor is relatively poorly-resistant to fire (Brown and Davis 1973) and is more highly shade tolerant than Pinus ponderosa and Pseudotsuga menziesii (Baker 1950). Thus, many habitat types within the Abies concolor series are dominated by Pinus ponderosa and Pseudotsuga menziesii in mid-seral stages, with Abies steadily gaining dominance as succession proceeds.

14. Abies concolor/Vaccinium myrtillus Habitat Type

GEOGRAPHY. Abies concolor/Vaccinium myrtillus is a minor habitat type occurring in the San Juan, Sangre de Cristo, and Jemez mountains.

VEGETATION. Overstories are highly-mixed, with seven coniferous species occurring together in some stands, i.e., Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus flexilis, Pinus ponderosa, and Pseudotsuga menziesii.

Acer glabrum, Arctostaphylos uva-ursi, Pachistima myrsinites, and Rubus parviflorus often co-dominate the conspicuous Vaccinium sp. layer of the understory (Figure 15). Many species of forb are usually present; among these are Erigeron eximius, Fragaria ovalis, and Lathyrus sp.

PHYSICAL SETTING. This habitat type occurs below the elevational limits of Abies lasiocarpa and Picea engelmannii dominance at approximately 2,600 to 2,800 m. The type occurs on steep, cold, northerly slopes. Soils are Cryochrepts, Cryoborolls, and Cryorthents.

ECOTONES. This type ecotones to Abies lasiocarpa/Vaccinium forest at higher elevations and to herb-rich mixed conifer forests at lower elevations.

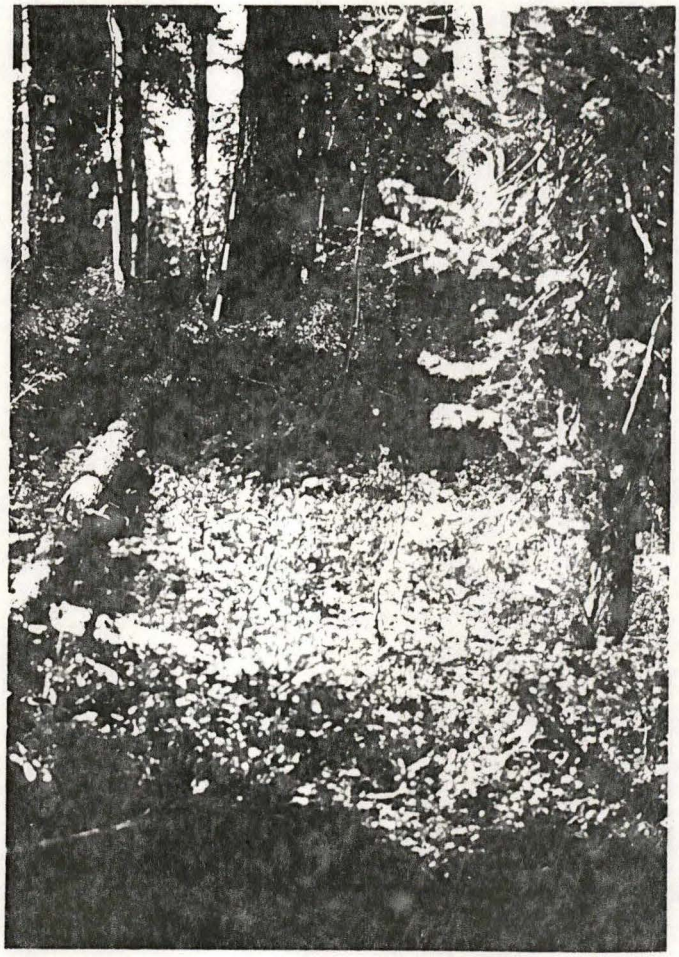

Figure 15. Abies concolor/Vaccinium myrtillus habitat type, San Juan Mountains. Tree and shrub diversity is high in this cold-moist mixed conifer habitat type. In this stand Vaccinium myrtillus, Mahonia repens, Amelanchier alnifolia, Symphoricarpus oreophilis, and Rubus parviflorus are all important components of the shrub layer.

COMMENTS. This type is found on the coldest sites in the Abies concolor series. Owing to the infrequent occurrence of the type, it is of relatively minor consequence for management. Pseudotsuga would generally be favored in timber management, but a Pseudotsuga monoculture would be difficult to maintain in this very mixed-conifer environment.

Livestock forage production is low and the potential for

increasing it is not great. Big game browse may be heavy and thinning the overstory will increase shrub cover.

The type has not previously been described in the southern Rocky Mountains. However, it is closely-related to Pseudotsuga menziesii/Pachistima myrsinites habitat type described in the central Rockies (Hoffman and Alexander 1980) and weakly-related to Abies grandis and Pseudotsuga menziesii/Vaccinium globulare habitat types of the northern Rockies (Pfister et al. 1977; Steele et al. 1981).

15. Abies concolor/Erigeron eximius Habitat Type

GEOGRAPHY. This type is relatively rare in Colorado but is common in the Jemez Caldera region and the Sangre de Cristo Range of New Mexico.

VEGETATION. Overstories are highly-complex. Abies concolor and Pseudotsuga menziesii co-dominate, but Picea pungens and Pinus flexilis may be important. In frost pockets, Abies lasiocarpa and Picea engelmannii may also occur. Pinus ponderosa is accidental or minor. Seral communities are dominated by Populus tremuloides.

Abies concolor/Erigeron eximius is a herb-rich habitat type (Figure 16). Artemesia franseriodes, Erigeron eximius, Carex foenea, Lathyrus sp., Oreochyrusum parryi, Fragaria sp., Bromopsis ciliata, Carex foenea and other moist-site herbs are characteristically of high cover (Table 3). Relative to the closely-related Abies concolor/Acer glabrum habitat type, shrubs are generally less important in this type. Canopy removal may cause substantial increases in shrub coverage.

PHYSICAL SETTING. All slopes, aspects, and landforms (other than ridges) are represented, but elevations cluster narrowly between 2,800

and 2,900 m. Sites are moist and protected from extreme sun and wind. Soils include Haploborolls and Dystrochrepts.

Figure 16. Abies concolor/Erigeron eximius habitat type, San Juan Mountians. Herb and sub-shrub diversity and cover is high. Erigeron eximius cover is 30 percent and total shrub cover (12 species) is 20 percent.

ECOTONES. The major ecotone is with Abies concolor/Acer glabrum habitat type. The two types intergrade, with the Erigeron type generally on deeper soils.

COMMENTS. Originally this type was described as a minor type by Moir and Ludwig (1979). Later, Ludwig et. al. (1981) treated it as a phase

of Abies concolor/Acer glabrum habitat type. However, the herb-rich character of the type is suggestive of environmental conditions divergent from the Acer type and thus its recognition as separate type is warrented. Fitzhugh et al. (1983) have recognized this as a distinct type in southern Arizona and New Mexico. General site characteristics are comparable with Abies grandis/Clintonia uniflora habitat type of Montana and central Idaho (Pfister et al. 1977; Steele et al. 1981).

Timber productivity may be high for Pseudotsuga. Livestock find little forage except in early successional stands. However, wildlife browse is favorable except in winter when heavy snow accumulations limit access.

16. Abies concolor/Acer glabrum Habitat Type

GEOGRAPHY. The type occurs throughout the study area except for the Dolores Mesa country of the far-western San Juan Mountains of Colorado, which is outside the range of Abies concolor.

VEGETATION. Tree species present are the same as those found in Abies concolor/Erigeron eximius habitat type. Shrubs dominate the understory (Figure 17). Acer glabrum, Amelanchier alnifolia, Jamesia americana, Mahonia repens, Pachistima myrsinites, and Physocarpus monogynus are often of high cover (Table 3). Many of the same herbs are found in this type as are in the Abies concolor/Erigeron eximius habitat type, but are typically of lower cover.

PHYSICAL SETTING. This is one of the most varied types in its topographic and vegetal characteristics. All slope aspects are represented and elevations span from 2,500 to 3,000 meters. Lower slopes are the

typical position on which the type occurs but many examples of the type can be found on mid and upper slopes.

This type typically occurs on relatively shallow, often skeletal, soils on very steep slopes. Borolls, Boralfs, and Ochrepts were all sampled within the type.

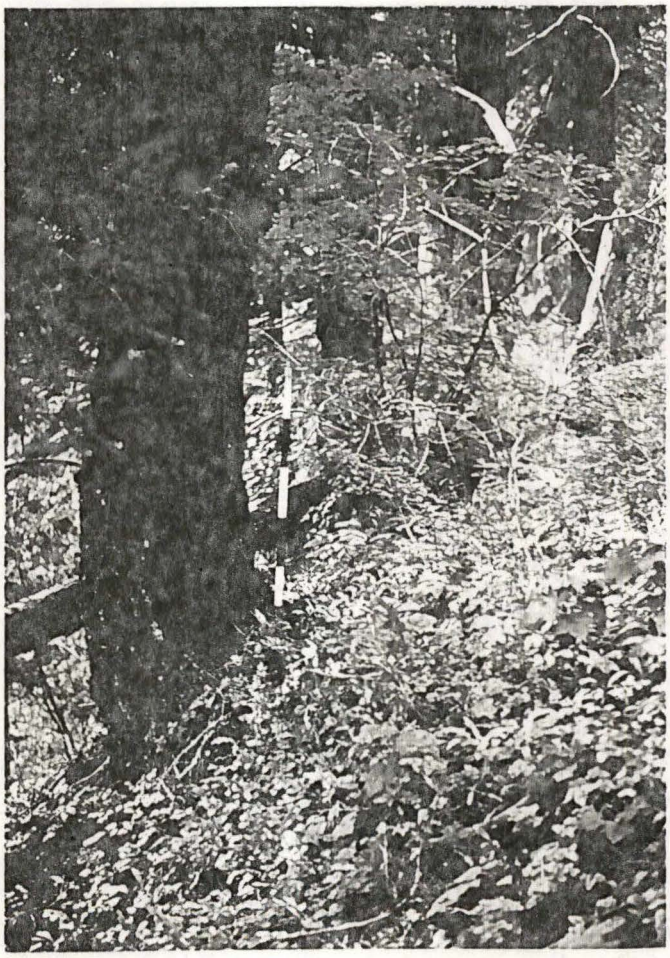

Figure 17. Abies concolor/Acer glabrum habitat type, San Juan Mountains. In contrast to the closely-related Abies concolor/Erigeron eximius habitat type, the tall shrub layer is strongly developed here. Of key importance is the dominance of Acer glabrum in the understory.

ECOTONES. This type intergrades to Abies concolor/Erigeron eximius habitat type in more mesic areas and to Abies concolor/Quercus

gambelii habitat type in more xeric situations. The type forms a lower elevation limit of many subalpine species.

COMMENTS. This type represents one of the most widespread among the mixed conifer forest. The type has previously been described from many forests in Arizona and New Mexico (Alexander 1981; Fitzhugh et al. 1983; Moir and Ludwig 1979) and is related to Pseudotsuga menziesii/Pachistima myrsinites habitat type of central and northern Colorado (Hess and Wasser 1982; Hoffman and Alexander 1980). Weakly-related types are represented by the Foothill ravine forest community of Rocky Mountain National Park, Colorado (Peet 1981) and the Abies grandis/Acer glabrum habitat type of central Idaho (Steele et al. 1981).

Owing to the cool, moist conditions characteristic of this habitat type fires are mostly light, erratic, and infrequent (Moir and Ludwig 1979). The erratic nature of fires has resulted in mozaics in forest structure within this type.

Timber productivity is poor to good. Pseudotsuga should regenerate well except when competition is severe with shrubs. Such competition may be particularly significant when shrub-growth is freed of suppression via canopy removal.

Old-growth stands offer scant forage for livestock and the typically steep slopes impede access. The type supplies prime forage and cover for big game. The shrubs provide abundant browse. Multistoried shrub layers increase micro-habitat diversity for birds (Fitzugh et al. 1983).

17. Abies concolor/SPARSE Habitat Type

GEOGRAPHY. This type is widespread within the study area.

VEGETATION. Overstories exhibit co-dominance of Abies concolor and Pseudotsuga menziesii. Pinus flexilis, Pinus ponderosa, Picea pungens, and Juniperus scopulorum are sometimes present.

Understories are characterized by sparsity, with only Symphoricarpus oreophilus ever attaining coverage in excess of 5 % (Table 3; Figure 18).

Figure 18. Abies concolor/SPARSE habitat type, San Juan Mountains. The sparse understory (typically less than five percent total cover) is characteristic of this type.

PHYSICAL SETTING. This relatively dry habitat type occurs on canyon sideslopes and ridges of all aspects between the elevations of 2,500 and 3,000 meters. Slopes are steep to very steep. Soil suborders include Ochrepts, Borolls, Boralfs, and Orthents.

ECOTONES. Ecotones occur with Abies concolor/Acer glabrum forests on moister sites and with Abies concolor/Quercus gambelii on warmer

sites. Cooler environments bordering this habitat type support forests represented by spruce-fir habitat types.

COMMENTS. Management for all but watershed and wildlife is marginal as timber productivity and forage yields are low. Some plots within this type fit the description of Pseudotsuga menziesii/Physocarpus monogynus habitat type described in northern New Mexico by Moir and Ludwig (1979). Soils are invariably skeletal within the Physocarpus-dominated forests and site potential is exceptionally low.

This type has previously been described in Arizona and New Mexico (Fitzhugh et al. 1983; Moir and Ludwig 1979). Weak similarities exist with Xeric Pseudotsuga forest communities in northern Colorado (Peet 1981) and Pseudotsuga menziesii/Arnica cordifolia habitat type described in the northern Rocky Mountains (Pfister et al. 1977; Steele et al. 1981).

Herb growth may be limited by seasonal soil water deficits and shading (Moir and Ludwig 1979). In some cases, the sparsity may represent intensive or prolonged wildlife browsing.

18. Abies concolor/Arctostaphylos uva-ursi Habitat Type

GEOGRAPHY. This type is of minor occurrence throughout the study area.

VEGETATION. Overstories are characterized by Abies concolor and Pseudotsuga menziesii, with Pinus ponderosa a major seral associate. Arctostaphylos dominates the understory along with Pachistima myrsinites in some stands (Table 3). Few other species ever attain 5 % cover (Figure 19). Arctostaphylos cover is highest in sunny openings.

PHYSICAL SETTING. This type seldom occurs on mid slope situations.

Most commonly it is found on ridgetops and occasionally on lower slopes. Slopes are moderate to steep and are of all aspects. Elevations range from 2,400 to 2,900 meters. Soils are Typic Udorthents and Typic Dystrochrepts.

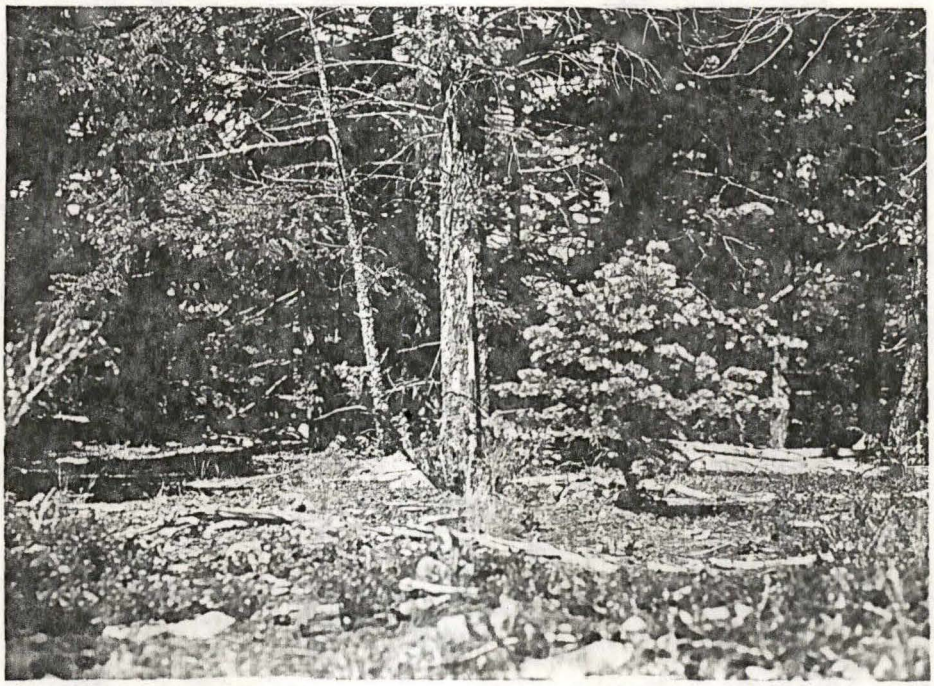

Figure 19. Abies concolor/Arctostaphylos uva-ursi habitat type, San Juan Mountains. Understory species diversity is high in this type (here 34 species), however, few species exceed one-percent cover. In this stand, Arctostaphylos uva-ursi cover is 15 percent and Festuca arizonica cover is two percent.

ECOTONES. This represents a dry-cool habitat within the zone of Abies concolor-Pseudotsuga menziesii codominance. On dry-warm situations Pinus ponderosa gains climax status within the Arctostaphylos zone and in dry-cold situations Abies concolor/Vaccinium forests are encountered.

COMMENTS. This relatively minor type is perhaps best-suited for wildlife use. Timber productivity is low and the xeric conditions of most stands may hinder regeneration following logging. Owing to low

snow accumulations, forests in this habitat type often provide winter range for wildlife.

Pfister et al. (1977) report a Pseudotsuga menziesii/ Arcto-staphylos uva-ursi habitat type in Montana that is weakly-similar to the type described here.

19. Abies concolor/Festuca arizonica Habitat Type

GEOGRAPHY. This relatively minor type primarily occurs in the Jemez and San Juan mountain region of New Mexico.

VEGETATION. Abies concolor and Pseudotsuga menziesii co-dominate. Pinus ponderosa is a important seral or minor climax species. Festuca arizonica, Danthonia parryi, Muhlenbergia montana, and Poa fendleriana presence attest to the "grassy" character of this types understory (Table 3; Figure 20). Shrub and forb cover is generally minor.

PHYSICAL SETTING. This type occurs on all aspects and slope positions within the elevation range of 2,500 to 3,100 meters. Slopes are moderate to steep. Climates are seasonally dry and are near the warm limits of mixed-conifer forests (Moir and Ludwig 1979). Soils include Argiborolls and Dystrochrepts.

ECOTONES. In warmer situations this type ecotones to Pseudotsuga menziesii or Pinus ponderosa/Festuca arizonica habitats, while cooler situations favor Picea pungens dominance.

COMMENTS. As with other grass-dominated habitats, grazing both by domestic stock and elk will be an important consideration within this type. Historically, fire commonly occurred within this type and served as a thinning-agent in the maintenance of open stands (Moir and

Ludwig 1979). The understory grasses are best expressed in the openings and a fire management program would thus enhance grazing opportunities. Caution is necesary in utilizing prescribed fire since years of fire suppression have favored heavy litter accumulations and thicket-growth conducive to conflagrations rather than light burns (Biswell et al. 1973).

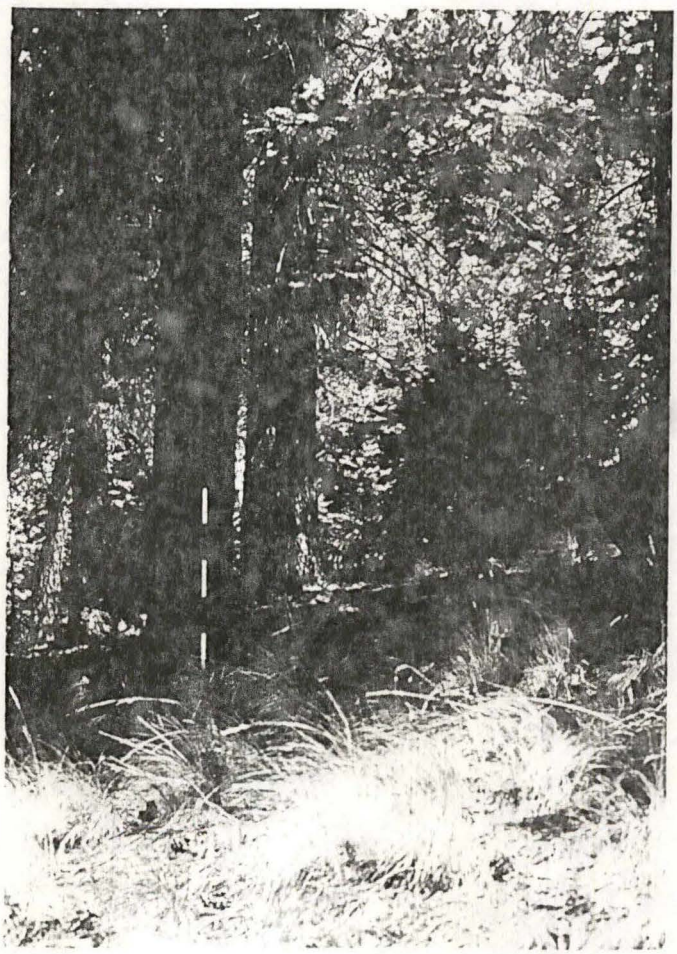

Figure 20. Abies concolor/Festuca arizonica habitat type, San Juan Mountains. Common species in this stand are Festuca arizonica, Muhlenbergia montana, Carex rossii, and Arctostaphylos uva-ursi

Timber management centers on either Pseudotsuga menziesii or Pinus ponderosa, or a combination of the two. Pinus ponderosa is near

its mesic limits in this type and its regeneration may be difficult due to competition from Abies and Pseudotsuga (Moir and Ludwig 1979).

This type has previously been reported in Arizona and New Mexico (Fitzhugh et al. 1983; Moir and Ludwig 1979).

20. Abies concolor/Quercus gambelii Habitat Type

GEOGRAPHY. This type is widespread throughout the southern Rocky Mountains and is the most widespread mixed-conifer habitat type within the study area.

VEGETATION. Abies concolor and Pseudotsuga menziesii co-dominate in the overstory. Pinus flexilis, Pinus ponderosa, and Populus tremuloides are common seral species. Quercus gambelii is the most characteristic understory species, often forming nearly impenetrable thickets (Figure 21). Symphoricarpus oreophilus and Rosa sp. are often important shrubs. Jamesia americana is an important moist-site shrub in this type. Other than Carex rossii, graminoid cover is scant. Forb species diversity is often high but total cover is generally less than 10 % (Table 3).

PHYSICAL SETTING. The type occurs on all landscape positions and aspects and on elevations ranging from 2,400 to 2,900 meters. Slopes vary from gentle to very steep. Soils are often in lithic subgroups.

ECOTONES. Ecotones with Pseudotsuga menziesii or Pinus ponderosa forests lacking an Abies component are often found. Wetter or cooler sites merge to Abies concolor/Acer glabrum while drier or warmer sites have grassy understories, e.g. Abies concolor/Festuca arizonica habitat type.

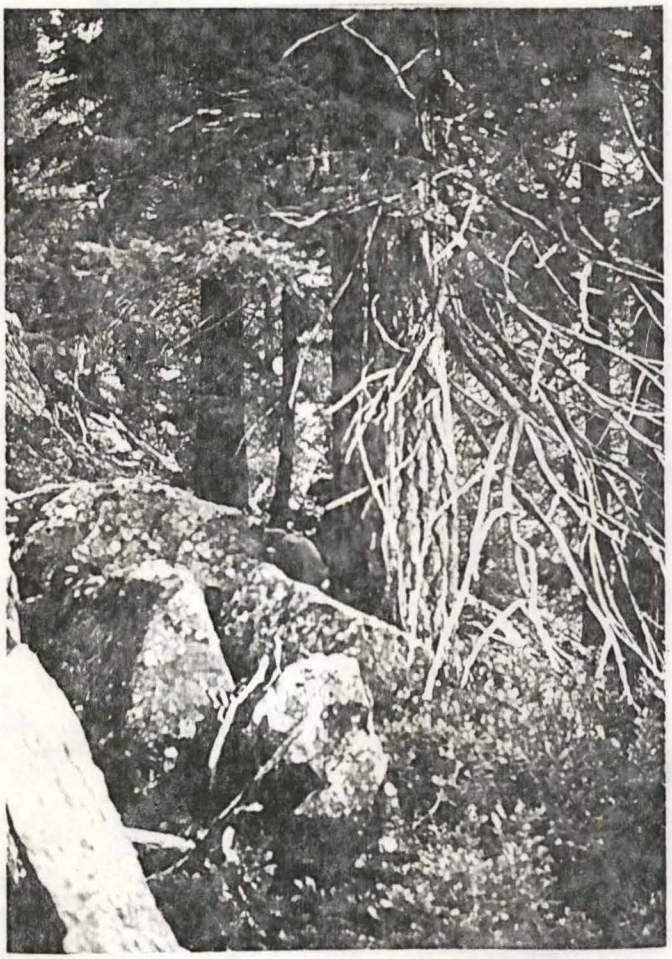

Figure 21. Abies concolor/Quercus gambelii habitat type, San Juan Mountains. This widespread type commonly occurs on skeletal soils in the mixed conifer zone. Dominance of Quercus gambelii is diagnostic for the type.

COMMENTS. This type has previously been described in Arizona and New Mexico (Alexander 1981; Fitzhugh et al. 1983; Moir and Ludwig 1979). Fire is a major component in the ecology of these forests and much of the high Quercus cover may relate to its ability to vegetatively reproduce after fire. Timber productivity is sometimes adequate to support logging operations. The type provides valuable cover and browse for deer populations.

Pseudotsuga menziesii Series

GEOGRAPHY. The Pseudotsuga menziesii series is relatively minor in the study area and is represented by only three habitat types: Pseudotsuga menziesii/Arctostaphylos uva-ursi, Pseudotsuga/Festuca arizonica and Pseudotsuga/Quercus gambelii.

VEGETATION. In addition to Pseudotsuga, Pinus ponderosa is often a dominant feature of the overstory. Warmer sites within the series may also feature Juniperus scopulorum and Pinus edulis while relativey cool envirionments feature Pinus flexilis (Picea engelmannii subdominant). At high elevations, Pinus aristata dominates or co-dominates. Abies concolor is absent or minor. Early successional forests are typically dominated by either Populus tremuloides (in the Pseudotsuga/Festuca arizonica and Pseudotsuga/Arctostaphylos uva-ursi habitat types) or Quercus gambelii (in the Pseudotsuga/Quercus habitat type).

Understories vary from grassy Festuca arizonica-dominated situations to non-grassy Quercus gambelii or Arctostaphylos uva-ursi-dominated situations. In the Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type herbaceous cover seldom exceeds trace amounts.

PHYSICAL SETTING. Steep slopes characterize this series. Elevations range from 2,000 to 3,000 m. Soils generally have udic moisture regimes at higher elevations and ustic moisture regimes at lower elevations. Temperature regimes are cryic in the Arctostaphylos type and are frigid elsewhere.

ECOTONES. Warm-dry sites favor the Pinus ponderosa series while

ecotones in moist environments are with the Abies concolor series. Most commonly, the Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type borders Abies lasiocarpa/Vaccinium habitat type on less-exposed and cooler environments within the same elevational zone. Ecotones to Abies concolor/ SPARSE habitat type are also to be expected.

COMMENTS. Pseudotsuga has the greatest ecological amplitude of any coniferous species in the study area. In the northern Rocky Mountains, Rehfeldt (1974) demonstrated substantial genetic variation among Pseudotsuga populations from contrasting habitats. This genetic diversity contributes to the broad ecological amplitude. However, Pseudotsuga is lower in shade tolerance relative to Abies sp. and thus is not considered climax in Abies sp. stands in which it co-occurs. Thus, the Pseudotsuga series is relatively minor in areal extent since few stands where Pseudotsuga is important are not co-dominated by more shade-tolerant species.

The Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type represents drier sites within the Abies lasiocarpa/Vaccinium zone. The exposed conditions favor snow movement rather than accumulation and the well-drained, skeletal soils do not provide suitable reservoirs to store adequate water to support Abies forest. Thus, the stands remain open, favoring the growth of "sun-loving" Arctostaphylos uva-ursi.

The series generally does not contain productive timberlands. Management would typically favor Pseudotsuga. Forage production for livestock is high in the Festuca arizonica-dominated forests. The relatively warm winter conditions and presence of big-game forage

species in the Arctostaphylos type make it locally important winter range. The large seeds of Pinus flexilis provide food for birds and small mammals.

21. Pseudotsuga menziesii/Arctostaphylos uva-ursi Habitat Type

GEOGRAPHY. Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type is of minor occurrence. The few samples were taken in the northern portion of the Sangre de Cristo Range in New Mexico and in the Wet Mountains of Colorado.

VEGETATION. Pinus flexilis dominates the overstory in all stands, with Pseudotsuga menziesii and Picea engelmannii often subdominant (Figure 22). Understories are characterized by a conspicuous Arctostaphylos uva-ursi layer and the common occurrence of Juniperus communis (Table 3). Herbaceous cover seldom exceeds trace amounts.

PHYSICAL SETTING. Elevations cluster around 3,000 m and landforms are steep southerly upper slopes. Soils typically are skeletal and are Dystric Cryochrepts or Typic Cryorthents.

ECOTONES. Most commonly, this type borders the Abies lasiocarpa/Vaccinium myrtillus habitat type on less-exposed and cooler environments within the same elevational zone. Ecotones to the Abies concolor/SPARSE habitat type are also to be expected.

COMMENTS. This habitat type represents drier sites within the Abies lasiocarpa/Vaccinium zone. The exposed conditions favor snow movement rather than accumulation and the well-drained, skeletal soils do not provide suitable reservoirs to store adequate water to support Abies forest. Thus, the stands remain open, favoring the growth of "sun-

loving" Arctostaphylos.

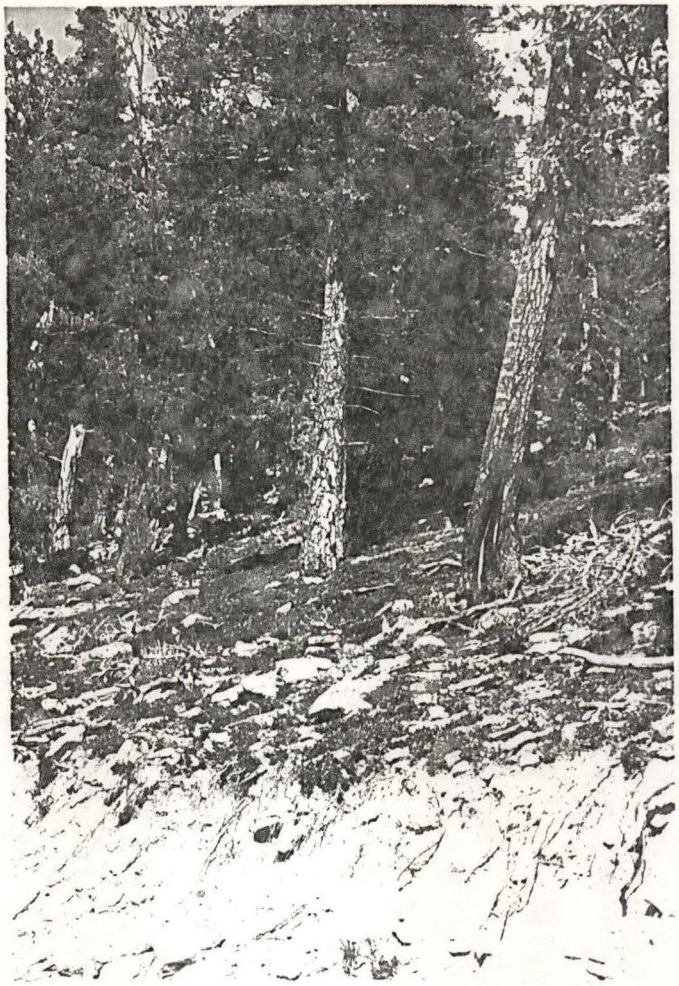

Figure 22. Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type, Sangre de Cristo Range. Pinus flexilis and Pseudotsuga menziesii co-dominate the canopy above the conspicuous Arctostaphylos uva-ursi growth.

The relatively warm winter conditions and presence of big-game forage species in this type make it important winter range. The large seeds of Pinus flexilis provide food for birds and small mammals. Livestock use is very light due to difficult accessibility and low graminoid production.

Timber productivity is low. Management would typically favor Pseudotsuga since Pinus flexilis is generally not an economically

important species. High surface soil temperatures combined with low soil moisture may hamper regeneration following logging (Pfister et al. 1977).

Highly-similar types have been described elsewhere. These include: the Pseudotsuga menziesii-Pinus strobiformis/Arctostaphylos uva-ursi habitat type in southern New Mexico (Fitzhugh et al. 1983), the Xeric Pinus contorta-Pseudotsuga forest communities in northern Colorado (Peet 1981), and the Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type in Montana (Pfister et al. 1977). Weak affinities are shared with the following types: the Pseudotsuga menziesii, Arctostaphylos uva-ursi, Juniperus communis habitat type in south-central Colorado (Shepherd 1975), and the Pinus flexilis/Juniperus communis habitat type in northern Colorado, central Idaho, and Montana (Hoffman and Alexander 1980; Pfister et al. 1977; Steele et al. 1981).

22. Pseudotsuga menziesii/Festuca arizonica Habitat Type

GEOGRAPHY. This is a minor type found in the mountains of southern Colorado and the northern Sangre de Cristo Range in New Mexico.

VEGETATION. With the exception of Abies concolor, all coniferous elements of mixed-conifer forest may be expected within this type. At high elevations, Pinus aristata dominates or co-dominates. The highly-varied understories are tied-together by Festuca arizonica dominance (Figure 23). Koeleria macrantha is always present and Muhlenbergia montana (up to 15 % cover) is often present. Arctostaphylos uva-ursi and Poa fendleriana are sometimes well-represented (Table 3).

Two phases are recognized:

Pinus aristata phase: P. aristata present

Pseudotsuga menziesii phase: P. aristata scarce or absent

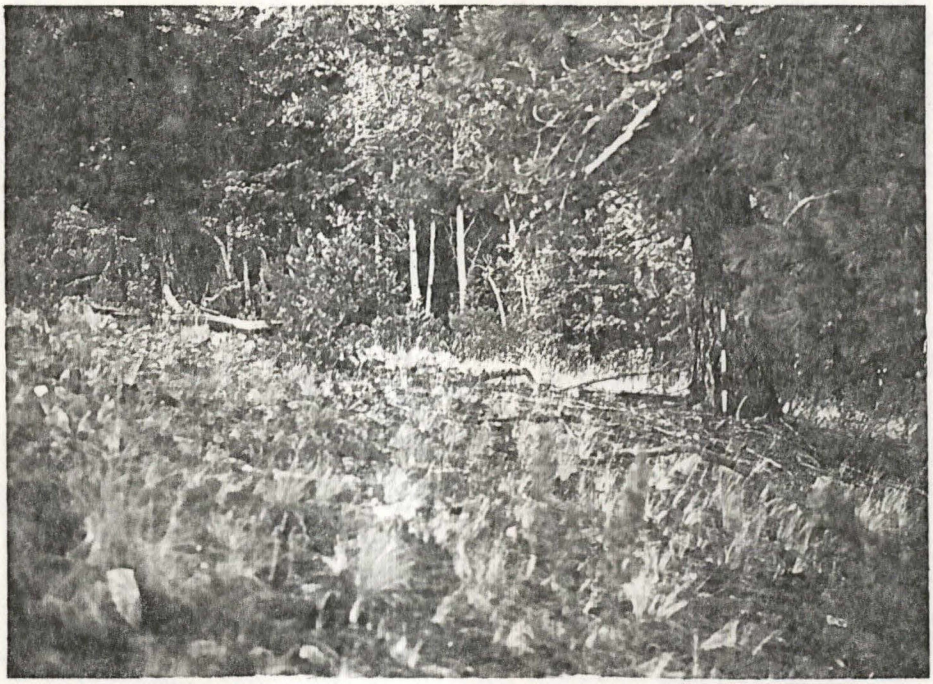

Figure 23. Pseudotsuga menziesii/Festuca arizonica habitat type, San Juan Mountains. Understories in this open-forest type are dominated by Festuca arizonica and Muhlenbergia montana.

PHYSICAL SETTING. This habitat type occurs most frequently on steeply-sloping southerly exposures in the 2,600 to 3,000 meter elevation range. Surface rock cover in excess of 15 % is a common feature. Soils include Borolls, Boralfs, Ochrepts, and Orthents.

ECOTONES. Close similarities occur between this and the Abies concolor/Festuca arizonica habitat type. The main feature diagnostic of this type is the absence of Abies concolor. This suggests warmer and drier conditions in this type relative to those featuring Abies. Quercus gambelii habitats occur in rockier situations. The type often adjoins meadows.

COMMENTS. As with other Festuca-dominated types, grazing is a prime

consideration for management. Deer, elk, and bighorn sheep find winter cover and forage in this type.

Timber productivity is low. Pseudotsuga and Pinus ponderosa are commercial species (in the Pseudotsuga phase) in this habitat type, but grass competition makes regeneration following logging difficult.

The type has been recognized in Arizona and New Mexico by Moir and Ludwig (1979) and Fitzhugh et al. (1983). In Colorado, Shepherd (1975) describes a complex of eight Pseudotsuga menziesii habitat types having "grassy" understories dominated by Festuca arizonica that are identifyable with the Pseudotsuga phase. The Pinus aristata phase is synonymous with the Pinus aristata, Festuca arizonica, Muhlenbergia montana, Ribes cerneum habitat type of Shepherd (1975). Similarities occur with the Pseudotsuga menziesii/Festuca idahoensis habitat type described in the northern Rockies (Pfister et al. 1977; Steele et al. 1981).

23. Pseudotsuga menziesii/Quercus gambelii Habitat Type

GEOGRAPHY. This type occurs throughout the study area.

VEGETATION. In addition to Pseudotsuga menziesii, Pinus ponderosa is often a dominant in the overstory.

Understories vary from non-grassy Quercus gambelii-dominated situations (Figure 24) to grassy Quercus gambelii-Festuca arizonica associations. Symphoricarpos oreophilus, Carex geyeri, and Muhlenbergia montana are important (Table 3).

Two phases are recognized:

Festuca arizonica phase: Festuca present

Quercus gambelii phase: Festuca absent

Figure 24. Pseudotsuga menziesii/Quercus gambelii habitat type, San Juan Mountains. The combined cover of the shrubs Quercus gambelii, Symphoricarpus oreophilus, Amelanchier alnifolia, Rosa woodsii, and Purshia tridentata equals 60 percent in this plot.

PHYSICAL SETTING. Slopes range from moderate to very steep, elevations vary from 2,000 to 2,800 meters, and stands were sampled on all aspects. Soils are predominately Eutroboralfs, Glossoboralfs, and Arigiborolls.

ECOTONES. This type occupies that position in the environmental gradient intermediate between the Abies concolor/Quercus gambelii

habitat type and the Pinus ponderosa/Quercus gambelii habitat type. Together these three habitat types form the most widespread forested union in the study area.

COMMENTS. As in the other Quercus habitats, oak is the most conspicuous feature of the vegetation. Grasses are commonly important in the understory, so this type has broad possibilities for management, ranging from timber production to forage utilization. Vertical diversity in this "shrubby" type supports varied bird species (Fitzhugh et al. 1983).

This type is reported from Arizona and New Mexico (Alexander 1981; Fitzhugh et al. 1983). Hess and Wasser (1982) described a highly similar type in central Colorado, i.e., Pinus ponderosa/ Quercus gambellii/ Carex geyeri habitat type. Weak affinities are shared with Mesic foothill woodland communities of northern Colorado (Peet 1981) and Pseudotsuga menziesii/Symphoricarpus oreophilus habitat type from the northern Rockies (Pfister et al. 1977; Steele et al. 1981).

Ponderosa Pine Forests

Pinus ponderosa Series

GEOGRAPHY. The *Pinus ponderosa* series is found throughout the low elevations of the study area. Unlike the broad geographical similarities within the *Abies lasiocarpa* series within the Rocky Mountains, few similarities exist within the *P. ponderosa* series on a regional basis.

VEGETATION. *Pinus ponderosa* is the least shade tolerant tree of the seven species considered in this study. Therefore, only those stands where *P. ponderosa* dominates the regeneration lie within the *P. pondersosa* series. In moister environments, *Pseudotsuga menziesii* may occur in minor amounts, and in warm-dry situations *Pinus edulis* and *Juniperus scopulorum* are important. *Quercus gambelii* is a common seral tree; although in areas lacking *Quercus*, succession to *P. ponderosa* is direct.

Dry-site understories are similar to adjacent non-forest communities. Grasses such as *Bouteloua gracilis*, *Schizachyrium scoparium*, *Poa fendleriana*, and *Muhlenbergia montana* are characteristic of such situations. Moist-site understories are similar to the *Pseudotsuga menziesii* series and are also similar to drier habitats in the *Abies concolor* series. In these cases, *Arctostaphylos uva-ursi*, *Quercus gambelii*, and *Festuca arizonica* may be important.

PHYSICAL SETTING. The series may be found on any slope or aspect between the elevational range of 1,800 to 2,900 m. Soils are generally frigid and ustic.

ECOTONES. The first forest type encountered above low-elevation

grasslands and pinyon-juniper woodlands is the Pinus ponderosa series. Except for Pinus edulis and Juniperus sp., P. ponderosa is the most drought resistant of the conifers in the study area. Following P. ponderosa in drought resistance is Pseudotsuga menziesii (Pharis 1966). Higher elevational ecotones are with the P. menziesii series. In some mesic situations, ecotones to the Abies concolor series occur.

COMMENTS. Surface fires are a natural component of the P. ponderosa cover type and served to maintain open park-like stands throughout much of the series (Cooper 1960). However, the advent of modern fire suppression has resulted in the establishment of dense patches of young trees in many areas. The added shade and needle accumulation under such patches hinders development of herbaceous understories (Daubenmire and Daubenmire 1968). In such situations, habitat type identification may be difficult due to low coverage or absence of indicator species. Furthermore, fire exclusion may favor reproduction of more shade tolerant species (e.g., Pseudotsuga menziesii, Abies concolor) that normally would not occur given a natural fire regime. Hence, presence of Pseudotsuga or Abies beneath a P. ponderosa overstory may not always indicate sites outside the P. ponderosa series if fire exclusion programs are in operation.

Pristine forests are more rare in the P. ponderosa series than in the other forest series. Grazing damage has been particularly severe and has resulted in conversions of grass-rich understories to weed-rich understories. Dominance of such species as Hymenoxys sp., Taraxacum officinale, Xanthocephalum sarothrae, Bromus tectorum, and Poa pratensis indicate overgrazing. Such pervasive alteration of the

understory adds to the difficulty in ascertaining the correct habitat type. In some cases, the alteration of soil and vegetation may be so severe that the potential of such habitats to support climax plant communities no longer exists.

Similarly, the ease of access of most habitats in the P. ponderosa series and the desirable properties of P. ponderosa lumber has resulted in heavy timber harvests throughout the series. The alteration of the tree canopy further adds to the difficulty in inferring tree stucture at climax.

In general, forests in the P. ponderosa series represent the least-productive timberlands. Regeneration is generally difficult since favorable seedcrops, favorable soil moisture, and open sites must coincide. Heavy grass cover and heavy livestock grazing severely impede regeneration. Since many P. ponderosa habitats are graminoid-rich, livestock grazing is a prime management directive. Recovery from overgrazing may require decades. Abundant big game browse is found in shrubby habitat types.

24. Pinus ponderosa/Arctostaphylos uva-ursi Habitat Type

GEOGRAPHY. Pinus ponderosa/Arctostaphylos uva-ursi is a minor habitat type found in the Jemez and Sangre de Cristo mountains of New Mexico and the Wet Mountains of Colorado.

VEGETATION. Pinus ponderosa dominates the tree layer with Peudotsuga menziesii of minor importance in some areas. Abies concolor is infrequent or absent in this habitat type. Arctostaphylos uva-ursi is conspicuous as the understory dominant and is diagnostic of this type (Table 4). Arctostaphylos cover ranges from 30 to 70% and generally it

Table 4. Species frequencies (FRQ) and average tree density or shrub-herb cover (CVR) for northern New Mexico-southern Colorado ponderosa pine habitat types.

HTS:	24		25A		25B		25C		26A		26B	
NO. PLOTS:	(10)		(7)		(18)		(8)		(21)		(26)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -												
JUNIPERUS MONOSPERMA-YNG REGEN	10	<1					25	<1				
JUNIPERUS MONOSPERMA-ADV REGEN							25	<1	4	<1		
JUNIPERUS MONOSPERMA-MATURE												
JUNIPERUS SCOPULORUM-YNG REGEN			14	<1	11	<1	63	2	24	<1	35	1
JUNIPERUS SCOPULORUM-ADV REGEN			14	<1	6	<1	25	<1	10	<1	23	<1
JUNIPERUS SCOPULORUM- MATURE							13	<1	5	<1	4	<1
PINUS EDULIS - YNG REGEN	10	<1	29	<1	56	2	75	6	38	<1	38	1
PINUS EDULIS - ADV REGEN					11	<1	75	4				
PINUS EDULIS - MATURE							13	<1				
PINUS PONDEROSA - YNG REGEN	100	45	100	11	94	9	63	6	90	5	96	7
PINUS PONDEROSA - ADV REGEN	100	18	71	4	94	5	88	6	95	11	88	7
PINUS PONDEROSA - MATURE	100	6	100	5	100	5	100	3	100	4	100	5
PSEUDOTSUGA MENZIESII-YNG REG	40	2	43	<1	22	<1			33	<1	27	<1
PSEUDOTSUGA MENZIESII-ADV REG	30	<1	14	<1	17	<1	13	<1	14	<1	23	<1
PSEUDOTSUGA MENZIESII- MATURE												
QUERCUS GAMBELII - YNG REGEN	10	<1	14	<1			13	<1	86	30	69	16
QUERCUS GAMBELII - ADV REGEN									52	3	31	3
- - S H R U B S - -												
ARCTOSTAPHYLOS UVA-URSI	100	44	29	<1	22	<1			10	<1	8	<1
CEANOTHUS FENDLERI	30	<1			6	<1	13	<1	24	<1	38	<1
CERCOCARPUS MONTANUS	40	<1	14	<1	56	<1	63	3	24	<1	69	3
MAHONIA REPENS	10	<1			6	<1			38	<1	42	<1
PURSHIA TRIDENTATA									10	<1	23	1
QUERCUS GAMBELII	40	<1	29	<1	22	<1	13	<1	100	26	100	25
QUERCUS GAMBELII X GRISEA	10	<1					38	1	10	2	15	2
QUERCUS GRISEA X GAMBELII	10	<1			6	<1					4	<1
QUERCUS GRISEA											4	<1
RHUS AROMATICA					6	<1	25	<1	5	<1	8	<1
RIBES CEREUM	10	<1	57	<1	50	<1	38	<1	14	<1	4	<1
SYMPHORICARPUS OREOPHILUS	20	<1	29	<1	44	<1	25	<1	57	3	35	1
YUCCA GLAUCA					17	<1	38	<1	5	<1	19	<1
- - G R A M I N O I D S - -												
ANDROPOGON GERARDI	10	<1			11	<1	50	<1	10	<1	15	<1
BLEPHARONEURON TRICHOLEPIS			29	<1	33	<1	63	<1	19	<1	19	<1
BOUTELOUA CURTIPENDULA					6	<1	38	<1	5	<1	23	<1
BOUTELOUA GRACILIS					17	<1	100	3	5	<1	19	<1
CAREX SPP.	50	<1	29	<1	22	<1	14	<1	31	<1		
CAREX HELIOPHILA	20	<1							14	<1	12	<1
CAREX ROSSII	30	1	43	3	67	<1	25	<1	48	1	65	2
DANTHONIA PARRYI			100	17					19	<1	8	<1
FESTUCA ARIZONICA	60	2	100	13	100	11	100	13	100	6		
KOELERIA MACRANTHA	90	<1	100	1	89	1	63	<1	81	1	69	<1
MUHLENBERGIA MONTANA	100	2	86	4	100	4	100	10	62	2	73	2
ORYZOPSIS HYMENOIDES			14	<1	11	<1	13	<1	14	<1	4	<1
POA FENDLERIANA	70	1	100	3	94	2	63	<1	95	2	96	3
SCHIZACHYRIUM SCOPARIUM	20	<1			22	<1	75	4	19	2	27	2
SITANION HYSTRIX	80	<1	100	2	83	<1	100	<1	86	<1	88	<1

Table 4. (continued)

HTS:	24		25A		25B		25C		26A		26B	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - F O R B S - -												
ACHILLEA MILLEFOLIUM	30	<1	57	2	33	<1			57	<1	35	<1
ANTENNARIA ROSEA	50	<1	100	2	67	<1	38	<1	76	<1	31	<1
ARTEMISIA CARRUTHII	20	<1	57	<1	44	<1	25	<1	14	<1	8	<1
ARTEMISIA LUDOVICIANA	30	<1	29	<1	50	<1	75	1	71	<1	73	<1
ERIGERON FLAGELLARIS	10	<1	57	<1	28	<1	75	<1	52	<1	31	<1
ERIGERON FORMOSISSIMUS	40	<1	57	1	28	<1			33	<1	15	<1
ERIGERON SUBTRINERVIS			57	<1	33	<1			43	<1	12	<1
HETEROTHECA FULCRATA	40	<1	29	<1	56	<1	75	<1	43	<1	50	<1
HYMENOXYS ACAULIS			14	<1	17	<1	25	<1	10	<1	15	<1
HYMENOXYS RICHARDSONII			29	<1	33	<1	38	<1	14	<1	12	<1
LOTUS WRIGHTII							25	<1	14	<1	23	<1
PEDICULARIS GRAYII												
POTENTILLA HIPPIANA	30	<1	100	3	78	<1	50	<1	52	<1	12	<1
SOLIDAGO SPP.	40	<1			11	<1	25	<1	19	<1	27	<1
VICIA AMERICANA	20	<1	43	1	6	<1			52	<1	27	<1

Table 4. (continued)

HTS:	27		28		29A		29B		30		31	
NO. PLOTS:	(9)		(14)		(14)		(18)		(9)		(1)	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - T R E E S - -												
JUNIPERUS MONOSPERMA-YNG REGEN	78	1	43	<1	50	4	61	2	22	1	100	2
JUNIPERUS MONOSPERMA-ADV REGEN			7	<1	21	<1	33	1			100	1
JUNIPERUS MONOSPERMA-MATURE												
JUNIPERUS SCOPULORUM-YNG REGEN	22	<1	21	1	36	1	44	4	44	1		
JUNIPERUS SCOPULORUM-ADV REGEN			14	1	21	<1	22	2	33	<1		
JUNIPERUS SCOPULORUM- MATURE					7	<1	17	<1	22	<1		
PINUS EDULIS - YNG REGEN	44	2	93	10	50	3	94	8	67	7		
PINUS EDULIS - ADV REGEN			100	4	29	<1	67	4	44	2		
PINUS EDULIS - MATURE			14	<1			11	<1	11	<1		
PINUS PONDEROSA - YNG REGEN	78	9	79	4	93	8	94	3	78	4	100	1
PINUS PONDEROSA - ADV REGEN	100	12	93	4	93	6	89	4	56	1	100	1
PINUS PONDEROSA - MATURE	100	5	100	3	100	3	100	3	89	2	100	1
PSEUDOTSUGA MENZIESII-YNG REG	11	<1	14	<1	21	<1	11	<1				
PSEUDOTSUGA MENZIESII-ADV REG			14	<1			6	<1				
PSEUDOTSUGA MENZIESII- MATURE												
QUERCUS GAMBELII - YNG REGEN	22	<1	71	14			22	2				
QUERCUS GAMBELII - ADV REGEN	33	2	43	2			22	<1				
- - S H R U B S - -												
ARCTOSTAPHYLOS UVA-URSI	11	<1	7	<1								
CEANOTHUS FENDLERI	33	<1										
CERCOCARPUS MONTANUS	33	<1	86	2	21	<1	17	<1	56	<1	100	<1
MAHONIA REPENS	11	<1	21	<1	14	<1						
PURSHIA TRIDENTATA			7	<1								
QUERCUS GAMBELII	33	1	100	18	7	<1	56	<1	11	<1		
QUERCUS GAMBELII X GRISEA	11	<1	29	8	14	<1	11	<1	33	2		
QUERCUS GRISEA X GAMBELII	11	<1	7	<1	7	<1	6	<1	67	22		
QUERCUS GRISEA			7	<1	14	<1	6	<1	44	11		
RHUS AROMATICA			21	<1	36	<1	39	<1	33	<1		
RIBES CEREUM			21	<1	21	<1	17	<1				
SYMPHORICARPUS OREOPHILUS	11	<1	21	<1			11	<1				
YUCCA GLAUCA	11	<1	36	<1			6	<1	11	<1		
- - G R A M I N O I D S - -												
ANDROPOGON GERARDI			21	<1	36	1	11	1	67	<1		
BLEPHARONEURON TRICHOLEPIS	22	<1	43	<1	64	4	39	2	56	1		
BOUTELOUA CURTIPENDULA			14	<1	29	<1	17	<1	67	<1		
BOUTELOUA GRACILIS	22	<1	57	<1	64	6	100	9	89	2		
CAREX SPP.	67	2	57	2	43	2	28	1	44	2		
CAREX HELIOPHILA	11	<1	14	<1	21	<1	17	1	22	1		
CAREX ROSSII	22	<1	29	1	14	<1	44	<1	22	<1		
DANTHONIA PARRYI												
FESTUCA ARIZONICA			57	2			6	<1	33	<1		
KOELERIA MACRANTHA	100	3	93	<1	64	<1	83	<1	78	<1		
MUHLENBERGIA MONTANA	100	9	86	3	86	5	83	2	100	5		
ORYZOPSIS HYMENOIDES			7	<1			6	<1			100	<1
POA FENDLERIANA	89	2	100	2	100	2	89	4	78	1		
SCHIZACHYRIUM SCOPARIUM	44	<1	29	1	100	15	50	<1	100	6	100	6
SITANION HYSTRIX	100	2	93	<1	86	1	100	<1	89	<1	100	<1

Table 4. (continued)

HTS:	27		28		29A		29B		30		31	
	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR	FRQ	CVR
- - F O R B S - -												
ACHILLEA MILLEFOLIUM	11	<1	7	<1	7	<1	11	<1				
ANTENNARIA ROSEA	67	<1	29	<1	43	<1	33	<1				
ARTEMISIA CARRUTHII	44	<1	21	<1	29	<1	56	<1				
ARTEMISIA LUDOVICIANA	33	<1	71	<1	43	<1	39	<1	89	1		
ERIGERON FLAGELLARIS	56	<1	50	<1	50	<1	50	<1	67	<1		
ERIGERON FORMOSISSIMUS	56	<1	21	<1	29	<1	11	<1				
ERIGERON SUBTRINERVIS	11	<1	21	<1	14	<1	6	<1				
HETEROTHECA FULCRATA	56	<1	64	<1	86	2	89	<1	78	<1	100	<1
HYMENOXYS ACAULIS	44	<1	29	<1	21	<1	33	<1	22	<1		
HYMENOXYS RICHARDSONII	67	<1	50	<1	7	<1	39	<1	11	<1		
LOTUS WRIGHTII	33	<1	14	<1	43	2	39	1				
PEDICULARIS GRAYII												
POTENTILLA HIPPIANA	22	<1	14	<1	7	<1						
SOLIDAGO SPP.	11	<1	21	<1	29	2	6	<1	44	<1		
VICIA AMERICANA			14	<1	14	<1	11	<1				

*
HT. 24 =PINUS PONDEROSA/ARCTOSTAPHYLOS UVA-URSI HT
HT. 25A =PINUS PONDEROSA/FESTUCA ARIZONICA HT, DANTHONIA PARRYI PH.
HT. 25B =PINUS PONDEROSA/FESTUCA ARIZONICA HT, FESTUCA ARIZONICA PH.
HT. 25C =PINUS PONDEROSA/FESTUCA ARIZONICA HT, BOUTELOUA GRACILIS PH.
HT. 26A =PINUS PONDEROSA/QUERCUS GAMBELII HT, FESTUCA ARIZONICA PH.
HT. 26B =PINUS PONDEROSA/QUERCUS GAMBELII HT, QUERCUS GAMBELII PH.
HT. 27 =PINUS PONDEROSA/MUHLENBERGIA MONTANA HT
HT. 28 =PINUS PONDEROSA-P. EDULIS/QUERCUS GAMBELII HT
HT. 29A =PINUS PONDEROSA/BOUTELOUA GRACILIS HT, SCHIZACHYRIUM SCOPARIUM PH.
HT. 29B =PINUS PONDEROSA/BOUTELOUA GRACILIS HT, BOUTELOUA GRACILIS PH.
HT. 30 =PINUS PONDEROSA/QUERCUS GRISEA HT
HT. 31 =PINUS PONDEROSA/ORYZOPSIS HYMENOIDES HT

is the sole dominant species (Figure 25). Occasional importance is expressed by the graminoids: Muhlenbergia montana (up to 5% cover), Festuca arizonica, Carex heliophila and C. rossii. Shrub cover other than Arctostaphylos is generally low; however, Quercus gambelii is often present. The sparse forb layer includes few species that ever exceed 1% cover; Lathyrus arizonicus is important in local situations.

Figure 25. Pinus ponderosa/Arctostaphylos uva-ursi habitat type, Wet Mountains. This habitat type is at the upper elevational limits of the Pinus ponderosa series (here 2,740 m). Open stands with understories dominated by Arctostaphylos uva-ursi are typical.

PHYSICAL SETTING. This type is primarily confined to lower slopes and ridges at elevations ranging from 2,350 to 2,800 m. The type occurs on all exposures and slope steepness from gentle to very steep. Ridge soils in this type belong to lithic subgroups while lower slope soils have moderately deep profiles.

ECOTONES. On ridges, Pinus ponderosa/Arcto-staphylos uva-ursi habi-

tat type intergrades with Abies concolor/Arctostaphylos uva-ursi habitat type at higher elevations and ecotones with Abies concolor/Quercus gambelii habitat type on upper north-facing slopes and Pinus ponderosa/Quercus gambelii habitat type on upper south-facing slopes.

On lower slopes, adjoining habitats include such grass-dominated types as Pinus ponderosa/Festuca arizonica habitat type and in moister situations the Picea pungens/Festuca arizonica habitat type. When Pinus ponderosa/Arctostaphylos uva-ursi habitat type occurs on a lower south-facing slope it will intergrade to Abies concolor/Arctostaphylos uva-ursi habitat type as the exposure shifts northward.

COMMENTS. This habitat type has not previously been described. However, it shares many characteristics of the Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type as defined in the mountains of southwestern New Mexico (Fitzhugh et al. 1981). The Pinus ponderosa/ Arctostaphylos uva-ursi habitat type is not widespread in the southern Rockies, as Arctostaphylos is generally absent in mountain floras to the south of the San Juan and Sangre de Cristo Mountains, but is a major element of many mountain floras to the north. Thus, the study area here lies at the south end of its range.

Fire is of major importance in maintaining this habitat type. The widespread occurrence of fire-scarred trees is suggestive of this importance. This type is at the cool limits of Pinus ponderosa growth and in the absence of fire would probably shift to Pseudotsuga menziesii and Abies concolor dominated stands. Thus, this type may represent a fire climax.

Site quality is poor for timber production. Wildlife use is moderate.

25. Pinus ponderosa/Festuca arizonica Habitat Type

GEOGRAPHY. This habitat type is widespread within the study area.

VEGETATION. Pinus ponderosa is the climax dominant, but Pseudotsuga menziesii is minor in some stands. Grass and sometimes forb dominance is diagnostic of this type with shrubs of distinctly secondary importance (Figure 26). Quercus gambelii never exceeded 5% cover. Poa fendleriana, Koeleria macrantha, and Sitanion hystrix are frequently important. Achillea millefolium, Antennaria rosea, Erigeron formossimus and Potentilla hippiana are locally abundant forbs (Table 4).

This habitat type has been divided into three phases:

Danthonia parryi phase: with Danthonia present

Festuca arizonica phase: Danthonia scarce or absent

Bouteloua gracilis phase: Bouteloua gracilis present

Pinus ponderosa is the climax dominant tree throughout the type with Festuca arizonica and Muhlenbergia montana consistently important understory grasses. Danthonia has up tp 60% cover in plots of its phase. The Bouteloua gracilis phase represents the hot-dry extreme of this type and features Pinus edulis and Juniperus sp. in the overstory.

PHYSICAL SETTING. The type occurs on all aspects and landscape positions from lower slopes to ridges within the elevational range of 2,200 to 2,900 m. Slope steepness varies from slight to very steep. Predominantly, soils are Borolls, but Boralfs and, to a lesser degree, Orthents and Ochrepts are also represented. Generally, the soils are low in coarse fragment content.

Figure 26. Pinus ponderosa/Festuca arizonica habitat type, San Juan Mountains. Festuca arizonica, Muhlenbergia montana, and Danthonia parryi are all well represented in this stand.

ECOTONES. The Pinus ponderosa/Festuca arizonica habitat type ecotones to Pinus ponderosa/Quercus gambelii habitat type Festuca arizonica phase where soil conditions become rockier. Where conditions become more mesic this type ecotones to forests dominated by Abies concolor/Festuca arizonica habitat type. Drier sites support less Festuca arizonica, with Bouteloua gracilis increasing in importance.

COMMENTS. This habitat type is the coolest and wettest of the grassy

Pinus ponderosa habitat types. Also, soils are typically deeper in this habitat type than in other related Pinus types.

High grass cover favors surface fires. In the absence of fire forest closure would occur and understory grass cover would be reduced.

Muhlenbergia montana is often a co-dominant understory grass. However, it has wide ecological amplitude (being important in many contrasting habitat types), thus, has low indicator value. Festuca arizonica has a relatively narrow ecological amplitude and is a highly diagnostic species.

High grass cover makes this type particularily desirable for livestock grazing. Forage allocation between big game and domestic stock should be a major management consideration. Overgrazing has been widespread in this habitat type and has reduced, or in some cases, eliminated Festuca arizonica. The occurrence of weedy species, such as Hymenoxys acaulis, H. richardsonii, Taraxacum officinale, Xanthocephalum sarothrae, Bromus tectorum, and Poa pratensis, indicates overgrazing. Many sites of deep loamy soils within the mesic end of Pinus ponderosa that currently lack Festuca, and are weedy, probably are within the Pinus ponderosa/Festuca arizonica habitat type.

The Danthonia parryi phase has not been described elsewhere; however, environmental conditions align closely with the Festuca scabrella phase of Pinus ponderosa/Festuca idahoensis habitat type described in Montana by Pfister et al. (1977). High Danthonia cover and relatively cool sites with deep soils characterize the phase. Site quality for tree growth within the Danthonia phase is moderate. This

phase is not widespread and thus is relatively unimportant from for timber production.

The Festuca arizonica phase of this type has been described in the Mogollon Mountains (Fitzhugh et al. 1983) and is comparable to the Pinus ponderosa/Festuca arizonica habitat type in northern Arizona (Hanks et al. 1977). Similar stands identified as Pinus ponderosa/Festuca idahoensis habitat type are recognized in the central and northern Rockies (Daubenmire and Daubenmire 1968; Hoffman and Alexander 1976; Pfister et al. 1977; Steele et al. 1981). The Festuca phase has poor to moderate site quality for timber production.

The Bouteloua gracilis phase has been described in northern Arizona by Hanks et al. (1977) and by Fitzhugh et al. (1983) in southwestern New Mexico and southeastern Arizona.

26. Pinus ponderosa/Quercus gambelii Habitat Type

GEOGRAPHY. This habitat type is found throughout the study area.

VEGETATION. Pinus ponderosa is the major climax dominant tree within this habitat type. P. edulis and Juniperus scopulorum are typically absent. Quercus gambelii trees and shrubs typify the understories; sometimes forming impenetrable thickets (Figure 27). Cercocarpus montanus is another characteristic shrub. Graminoids occurring across this habitat type include Bouteloua gracilis, Carex rossii, C. heliophila, Koeleria macrantha, Muhlenbergia montana, Poa fendleriana, and Sitanion hystrix. Artemisia ludoviciana and Achillea millefolium are the most characteristic forbs (Table 4).

Two phases are recognized:

Festuca arizonica phase: Festuca is present

Quercus gambelii phase: Festuca absent or minor

The Festuca phase generally features co-dominance in the understory of both Festuca arizonica and Muhlenbergia montana.

In the Quercus phase few understory species with high cover consistently occur. Individual forb species seldom exceed 1% cover. The grass, Poa fendleriana is often diagnostic of the understory with cover averaging 5 %.

Figure 27. Pinus ponderosa/Quercus gambelii habitat type, Spanish Peaks. Pinus flexilis is a minor component in this stand. The understory is dominated by Quercus gambelii (35 percent cover). The only other understory species exceeding one percent cover is Carex rossii (here four percent cover).

PHYSICAL SETTING. This type encompasses considerable topographic variation. Elevations range from 2,100 to 2,800 m. Slopes from gentle to very steep are encountered, and soils from shallow to deep are found. Typical soil subgroups include Mollic Eutroboralfs, and Typic and Lithic Argiborolls or Eutroboralfs.

ECOTONES. As conditions become wetter and/or cooler this type intergrades to Abies concolor or Pseudotsuga menziesii/ Quercus gambelii habitat type. In contrast, warmer and drier conditions cause a shift to pinyon-juniper woodland or Pinus ponderosa-Pinus edulis/Quercus gambelii habitat type. Mosaics of the Pinus ponderosa/Quercus gambelii habitat type and grassy Pinus ponderosa habitat types often form on a given slope in response to microhabitat variations. Quercus typically dominates rocky sites while grasses dominate sites with deeper soils. This is consistant with Peet's (1981) finding that shrubs dominate on rocky sites, and grasses dominate on finer-textured soils.

COMMENTS. Of 156 plots sampled in the Pinus ponderosa series for northern New Mexico and southern Colorado, 48 are classified into the Pinus ponderosa/Quercus gambelii habitat type. This attests to the widespread importance of this type in the southern Rocky Mountains.

As is the case with all habitat types in the Pinus ponderosa series, fire is an important ecological factor in successions leading to this habitat type. Soon after catastrophic fire, Quercus gambelii forms dense thickets by extensive root sprouting. Competition is severe against the establishment of conifers during this persistent Quercus stage of succession (Hanks 1966). Certain areas where Quercus forms "pure" stands with no hint of conifer establishment may in fact represent a Quercus gambelii climax series (Brown 1958).

Although livestock grazing is common in this type, dense oak thickets and a general lack of surface water make grazing difficult in many areas, and forage production is low. However, Quercus and Cercocarpus are favorable browse and receive moderate to heavy use by deer

and elk.

Release of Quercus gambelii following logging or fire present difficult Pinus ponderosa regeneration problems. Site quality is generally poor.

The Quercus phase of this habitat type has previously been described for southern New Mexico and southeastern Arizona (Alexander 1981; Fitzhugh et al. 1983). In northern Arizona a related Pinus ponderosa/Festuca arizonica habitat type, Quercus gambelii phase has been described (Hanks et al. 1977). This habitat type is very similar to the Festuca phase described here except for a shift in the balance between Quercus and Festuca cover. Hess and Wasser (1982) describe a related Pinus ponderosa/Quercus gambelii/Carex geyeri habitat type in central Colorado. Steele et al. (1981) describes a weakly-related Pinus ponderosa/Symphoricapus oreophilus habitat type in central Idaho.

27. Pinus ponderosa/Muhlenbergia montana Habitat Type

GEOGRAPHY. This habitat type is mostly located on the Coyote Ranger District in the San Juan Mountains of New Mexico. Occasional expamples of the type occur in the Sangre de Cristo Range.

VEGETATION. Pinus ponderosa is the only tree consistently dominant in this habitat type. Grass species other than Koeleria macrantha, Muhlenbergia montana, Poa fendleriana, and Sitanion hystrix are of low frequency (Figure 28). In the absence of other indicator species, the ubiquitous Muhlenbergia montana is considered diagnostic. Up to 5% cover of Quercus gambelii occurs in this habitat type. Characteristic herbs include: Arenaria fendleri, Erigeron flagellaris and E. formosissimus (Table 4).

Figure 28. Pinus ponderosa/Muhlenbergia montana habitat type, San Juan Mountains. Understories are graminoid-rich. In this stand Muhlenbergia montana, Poa fendleriana, Koeleria macrantha, Sitanion hystrix, and Carex heliophila are all common.

PHYSICAL SETTING. This habitat type characteristically occurs on gently sloping ridges, mesa tops, and benches between the elevations of 2,300 and 2,600 m. The soil surface is covered with litter with little rock and bare soil. Soils are shallow to deep and have loamy to clayey textures with low to high coarse fragment contents. Typical soil great groups include Ustorthents, Ustochrepts, and Eutroboralfs.

ECOTONES. This type often forms a mosaic with the Pinus ponderosa/Quercus gambelii habitat type. As environmental conditions become mesic, the type ecotones to the Pinus ponderosa/Festuca arizonica habitat type. With more xeric conditions, this habitat type intergrades to the Pinus ponderosa/Bouteloua gracilis habitat type.

COMMENTS. This habitat type has previously been described in the Mogollon Mountains of southwestern New Mexico (Fitzhugh et al. 1983). Further, Peet (1981) identified Xeric foothill and montane woodland communities in northern Colorado that are closely-similar to the type.

Since the Pinus ponderosa/Muhlenbergia montana habitat type generally occurs on gentle topography and has good forage production potential, heavy grazing has been of widespread occurrence. In some areas it is difficult to determine if the absence or low cover of such indicator species as Festuca arizonica or Schizachyrium scoparium is an artifact of disturbance to which Muhlenbergia montana is not as sensitive. Timber productivity is also low in this type.

28. Pinus ponderosa-Pinus edulis/Quercus gambelii Habitat Type

GEOGRAPHY. This type was found only in the mountains of northern New Mexico.

VEGETATION. Co-dominance of Pinus ponderosa and Pinus edulis is expressed in the overstory. All plots in this habitat type contain Pinus edulis advanced regeneration (Figure 29). As in other Quercus gambelii habitats, Quercus is the dominant understory component. Graminoids are of secondary importance in the understory with Koeleria macrantha, Poa fendleriana, Muhlenbergia montana, and Sitanion hystrix being the most conspicuous species (Table 4). Occasionally, Bouteloua gracilis attains 5 % cover. Rarely do forbs other than Artemesia ludoviciana exceed 1 % cover.

PHYSICAL SETTING. This widespread habitat type occurs on moderate to steep canyon sideslopes in the 2000 - 2700 m elevation range. The type can occur on any aspect. Soils are generally Typic, Mollic or

Lithic Eutroboralfs or Typic Ustorthents.

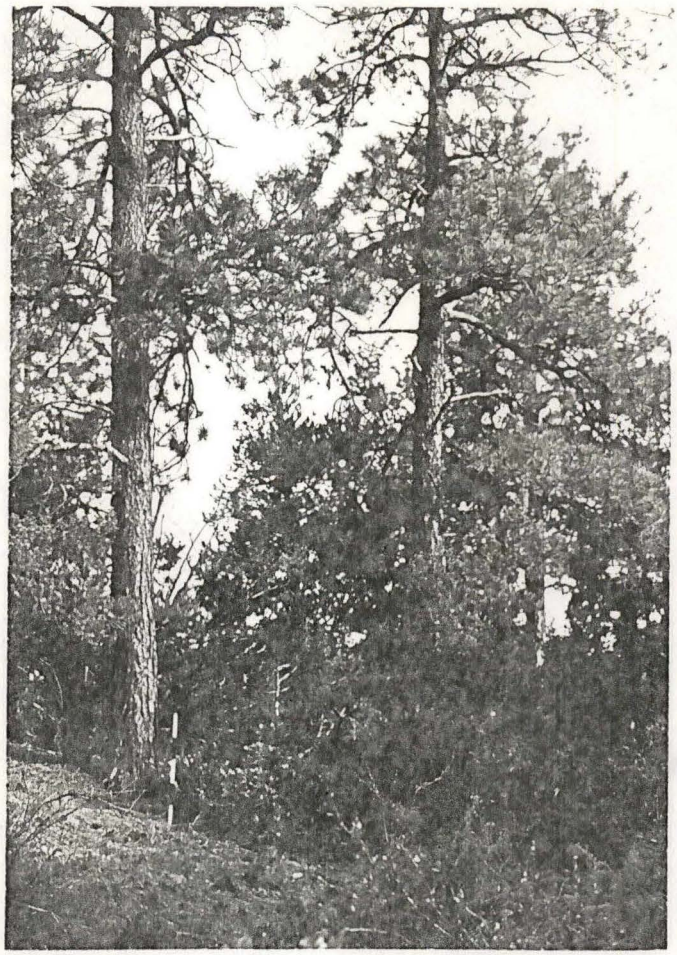

Figure 29. Pinus ponderosa-Pinus edulis/Quercus gambelii habitat type, San Juan Mountains. The presence of Pinus edulis as a dominant conifer in this stand is suggestive of the types warm-dry character.

ECOTONES. Commonly, ecotones with Pinus ponderosa/Quercus gambelii habitat type occur on slightly moister situations, and with Pinus ponderosa/Quercus grisea habitat type under drier conditions.

COMMENTS. The Quercus habitat types in the Pinus ponderosa series are closely similar ecologically with slight shifts in moisture-temperature status causing shifts in dominance of Pinus edulis and Quercus

p.

Close affinities occur between this habitat type and that portion of Pinus ponderosa/Quercus gambelii habitat type described in New Mexico and Arizona by Alexander (1981) and Fitzhugh et al. (1983) that has a high representation of Pinus edulis. Hanks et al. (1977) describes a Pinus ponderosa/Bouteloua gracilis habitat type, Quercus gambelii phase that is comparable to the type described here.

29. Pinus ponderosa/Bouteloua gracilis Habitat Type

GEOGRAPHY. This habitat type occurs in both the San Juan Mountains and the Sangre de Cristo Range of New Mexico.

VEGETATION. Generally, Pinus ponderosa and P. edulis co-dominate the tree stratum. Juniperus monosperma and J. scopulorum are of frequent importance. Quercus gambelii is generally present but poorly represented. Total shrub cover seldom exceeds 1 %. Bouteloua gracilis or Schizachyrium scoparium are diagnostic of the type and sometimes share high coverage with Blepharoneuron tricholepis, Muhlenbergia montana, Poa fendleriana, and Sitanion hystrix (Table 4; Figure 30). Lotus wrightii is an important understory component in some sites.

Two phases of this habitat type are recognized:

Schizachyrium scoparium phase: Schizachyrium is well-represented

Bouteloua gracilis phase: Schizachyrium poorly-represented or absent

The Schizachyrium phase is weakly similar to the Pinus ponderosa/Andropogon habitat type described in Montana by Pfister et al. (1977). The phase is most extensive on the eastern slope of the Sangre de

Cristo Range in New Mexico where elements of the Great Plains, such as Schizachrium are common. Schizachyrium scoparium is high palatable and susceptable to damage from excess grazing pressure.

The Bouteloua phase has been described in northern Arizona by Hanks et al. (1977) and by Fitzhugh et al. (1983) in southwestern New Mexico and southeastern Arizona. This and the Schizachrium phase represent sites at or near the hot-dry extremes of Pinus ponderosa growth.

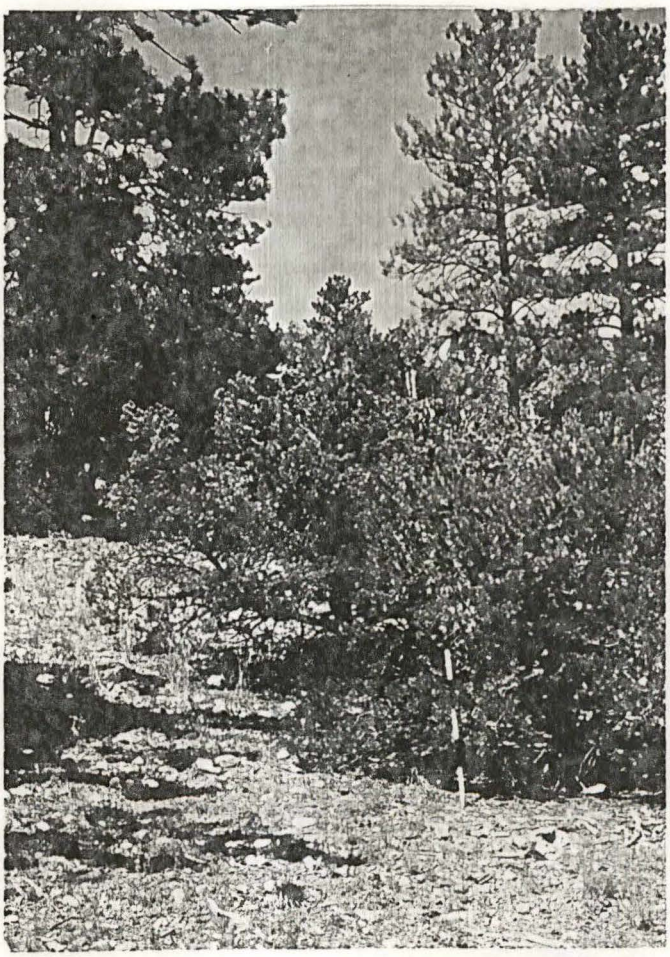

Figure 30. Pinus ponderosa/Bouteloua gracilis habitat type, Sangre de Cristo Range. This type is near the warm-dry extreme of Pinus ponderosa growth (elevation here is 2,220 m). Pinus edulis and Juniperus scopulorum co-dominate the coniferous overstory with Pinus ponderosa and such warm-dry indicators as Bouteloua gracilis, B. curtipendula, and Schzachrium scoparium are present in the understory.

PHYSICAL SETTING. It occurs on all aspects and on gentle to steep slopes, from lower slopes to mesa-tops and benches. Elevations range 1,900 and 2,600 m. Soils vary from sandy to clayey textures and from low to high coarse fragment content. Taxonomically, soils in this type are quite variable.

ECOTONES. On rocky slopes, this type merges with the Pinus ponderosa/Quercus gambelii (or Q. undulata) habitat type. Pinyon-juniper woodland forms the lower ecotone with this habitat type. The type occurs near the xeric limit of Pinus ponderosa growth.

COMMENTS. This moderately extensive habitat type characteristically supports open stands bordering on pinyon-juniper woodlands or sagebrush meadows. The high cover of grasses makes this habitat type valuable for grazing by domestick stock and wildlife. Hanks et al. (1977) suggest that Bouteloua gracilis often gains dominance in xeric Festuca arizonica habitats that have experienced overgrazing. Therefore care must be taken regarding disturbance regimes when attempting to identify habitat types in dry-grassy Pinus ponderosa communities.

Site quality for Pinus ponderosa is generally low. However, site potential is good on some sites where soils are high in pumice content. One tree was 16.5 m tall at 41 years in one stand with pumice soils.

30. Pinus ponderosa/Quercus undulata Habitat Type

GEOGRAPHY. This type is most common in northern New Mexico on the eastern foothills of the Sangre de Cristo Range and is rare in Colorado and in the San Juan Mountains of New Mexico.

VEGETATION. Pinus ponderosa is the indicated climax in this habitat type with P. edulis and Juniperus scopulorum frequently co-dominants. Understories are characterized by an assortment of hot-dry indicators (Figure 31). Quercus undulata exhibits up to 65% cover. Species of Opuntia, Echinocereus, and Yucca are usually present. Schizachyrium scoparium, Bouteloua gracilis, and Muhlenbergia montana are dominant understory grasses. Andropogon gerardi is typically present. Other than Artemisia ludoviciana, forb cover is generally less than 1% (Table 4).

Figure 31. Pinus ponderosa/Quercus undulata habitat type, Sangre de Cristo Range. Pinus edulis and Juniperus scopulorum are typically important in this type. In addition to Quercus undulata, this stand supports a common representation of Bouteloua gracilis and Schizachrium scoparium.

PHYSICAL SETTING. This habitat type occurs on mesa tops with lithic, sandy to loamy soils and on canyon sideslopes with typically shallow

coarse to fine textured soils. Elevations range for 2,000 to 2,500 m. The type occurs on all aspects; surface rock cover is generally high, averaging 27 %.

ECOTONES. This habitat type has close similarity to two New Mexico habitat types: Pinus ponderosa/Quercus grisea defined in the Mogollon Mountains (Fitzhugh et al. 1983) and Pinus ponderosa/Muhlenbergia dubia, Quercus undulata phase of the Sacramento Mountains (Alexander 1981). In northern New Mexico it shares close affinities to the Pinus ponderosa-Pinus edulis/Quercus gambelii habitat type and intergrades at the hot-dry limits of that type. Both of these habitat types are characterized by a rich compliment of grasses. On a single 375 m-square plot, 10 to 15 grasses may be encountered. On hotter and drier sites, this habitat type ecotones with Pinyon-Juniper woodland.

COMMENTS. Quercus undulata occupies sites at the hot and dry limits of Q. gambelii. Individuals with coriaceous leaves lacking distinct lobes were considered Q. undulata while thin,lobed leaved individuals were considered Q. gambelii. The two habitats in which these two oak variants occur seems to be intrinsically different and worthy of distinction into separate habitat types. Of those sites where Quercus is important, the Pinus ponderosa/Quercus undulata habitat type represents the hot-dry extreme.

Because of the environmental rigors of this habitat type, site potential for timber production is very low.

Livestock grazing in this habitat type is faced with the same difficulties as mentioned for the Pinus ponderosa/Quercus gambelii habitat type, i.e. general unavailability of surface water, impenetrable oak thickets, and typically low forage production.

31. Pinus ponderosa/Orysopsis hymenoides Habitat Type

GEOGRAPHY. This minor type occurs on stabilized sand dunes in the vicinity of Espanola, New Mexico and on the eastern edge of Colorado's Great Sand Dunes.

VEGETATION. Pinus ponderosa and Juniperus monosperma typify the very open stands. Species occurring in this type are characteristic of the warmest-driest of forested habitats. Orysopsis hymenoides, Poliomentha incana, and Andropogon scoparius are understory components (Table 4).

PHYSICAL SETTING. The one plot sampled was at 1,800 m elevation on a dry westerly exposure of a stablized dune.

ECOTONES. Where vegetation has not yet gained a foothold the type ecotones to active sand dunes while less-sandy environments support Pinus ponderosa/Quercus undulata associations or pinyon-juniper woodland.

COMMENTS. This type is of little consequence for management due to its rare occurrence. Berry (1963) describes similar Pinus ponderosa forests occupying sandy soils at the forest-steppe ecotone in central Oregon.

Other Vegetation Types

SCREE Forests

GEOGRAPHY. SCREE occurs throughout the study area.

VEGETATION. SCREE occurs in all forest series. Typically, shrubs are the dominant understory vegetation (Table 5). Where Pinus ponderosa composes the overstory, Quercus gambelii and Ribes sp. characterize the understory; Abies concolor forested scree have understories with Holodiscus dumosus and Jamesia americana. Juniperus communis and Saxifraga bronchialis characterize Picea engelmannii scree (Figure 32).

Figure 32. SCREE forest in the Sangre de Cristo Range. SCREE occurs in all forest series. Shown here is a SCREE slope supporting Abies lasiocarpa with an understory of Lonicera involucrata and Juniperus communis common in the shrub layer and Erigeron vetensis and Saxifraga bronchialis as common herbs.

PHYSICAL SETTING. This type is found on steep slopes of any exposure. Mineral soil is confined to pockets between coarse rock fragments

Table 5. Species frequencies (FRQ) and average tree density or shrub-herb cover (CVR) for northern New Mexico-southern Colorado scree and riparian habitats.

SCREE	NO. PLOTS:	(19)		RIPARIAN	NO. PLOTS:	(24)	
		FRQ	CVR			FRQ	CVR
- - T R E E S - -				- - T R E E S - -			
ABIES CONCOLOR - YNG REGEN		21	<1	ABIES CONCOLOR - YNG REGEN		58	18
ABIES CONCOLOR - ADV REGEN		11	<1	ABIES CONCOLOR - ADV REGEN		54	6
ABIES CONCOLOR - MATURE		16	<1	ABIES CONCOLOR - MATURE		33	1
ABIES LASIOCARPA - YNG REGEN		16	<1	ABIES LASIOCARPA - YNG REGEN		13	<1
ABIES LASIOCARPA - ADV REGEN		21	1	ABIES LASIOCARPA - ADV REGEN		8	<1
ABIES LASIOCARPA - MATURE		16	<1	ABIES LASIOCARPA - MATURE		4	<1
JUNIPERUS SCOPULORUM-YNG REGEN		21	<1	ACER NEGUNDO - YNG REGEN		8	<1
JUNIPERUS SCOPULORUM-ADV REGEN		5	<1	ACER NEGUNDO - ADV REGEN		8	1
JUNIPERUS SCOPULORUM- MATURE				ACER NEGUNDO - MATURE		8	<1
PICEA ENGELMANNII - YNG REGEN		47	1	JUNIPERUS SCOPULORUM-YNG REGEN		38	2
PICEA ENGELMANNII - ADV REGEN		42	2	JUNIPERUS SCOPULORUM-ADV REGEN		21	<1
PICEA ENGELMANNII - MATURE		42	2	PICEA ENGELMANNII - YNG REGEN		17	<1
PINUS ARISTATA - YNG REGEN		21	<1	PICEA ENGELMANNII - ADV REGEN		21	1
PINUS ARISTATA - ADV REGEN		5	<1	PICEA ENGELMANNII - MATURE		13	<1
PINUS ARISTATA - MATURE		5	<1	PICEA PUNGENS - YNG REGEN		63	6
PINUS EDULIS - YNG REGEN		11	<1	PICEA PUNGENS - ADV REGEN		63	6
PINUS EDULIS - ADV REGEN		5	<1	PICEA PUNGENS - MATURE		50	3
PINUS EDULIS - MATURE				PINUS PONDEROSA - YNG REGEN		8	<1
PINUS FLEXILIS - YNG REGEN		26	1	PINUS PONDEROSA - ADV REGEN		25	2
PINUS FLEXILIS - ADV REGEN		16	<1	PINUS PONDEROSA - MATURE		25	<1
PINUS FLEXILIS - MATURE		21	<1	POPULUS ANGUSTIFOLIA-YNG REGEN		29	5
PINUS PONDEROSA - YNG REGEN		11	<1	POPULUS ANGUSTIFOLIA-ADV REGEN		29	<1
PINUS PONDEROSA - ADV REGEN		21	<1	POPULUS ANGUSTIFOLIA-MATURE		38	<1
PINUS PONDEROSA - MATURE		26	<1	PSEUDOTSUGA MENZIESII-YNG REG		67	4
POPULUS TREMULOIDES-YNG REGEN		16	4	PSEUDOTSUGA MENZIESII-ADV REG		54	1
POPULUS TREMULOIDES-ADV REGEN		16	1	PSEUDOTSUGA MENZIESII- MATURE		17	<1
POPULUS TREMULOIDES-MATURE				QUERCUS GAMBELII - YNG REGEN		25	3
PSEUDOTSUGA MENZIESII-YNG REG		37	1	QUERCUS GAMBELII - ADV REGEN		21	3
PSEUDOTSUGA MENZIESII-ADV REG		32	<1	- - S H R U B S - -			
PSEUDOTSUGA MENZIESII- MATURE		37	1	ACER GLABRUM		42	7
- - S H R U B S - -				ACER NEGUNDO		21	5
ACER GLABRUM		5	<1	ALNUS SPP.		33	5
CERCOCARPUS MONTANUS		16	1	ALNUS TENUIFOLIA		25	5
HOLODISCUS DUMOSUS		32	1	CLEMATIS COLUMBIANA		17	<1
JAMESIA AMERICANA		21	<1	CLEMATIS LIGUSTICIFOLIA		17	2
JUNIPERUS COMMUNIS		53	2	JAMESIA AMERICANA		13	2
PENTAPHYLLOIDES FLORIBUNDA		16	<1	LONICERA INVOLUCRATA		29	2
QUERCUS GAMBELII		5	<1	MAHONIA REPENS		25	<1
RIBES CEREUM		26	<1	PACHISTIMA MYRSINITES		42	2
RIBES INERME		26	<1	PRUNUS VIRGINIANA		42	1
RIBES MONTIGENUM		37	<1	QUERCUS GAMBELII		58	9
RIBES WOLFII		21	<1	RIBES INERME		42	2
ROSA SPP.		16	<1	RIBES MONTIGENUM		17	<1
SYMPHORICARPUS OREOPHILUS		21	<1	ROSA SPP.		62	2

Table 5. (continued)

SCREE	FRQ	CVR	RIPARIAN	FRQ	CVR
--GRAMINOIDS--					
CAREX GEYERI	11	<1	RUBUS PARVIFLORUS	17	<1
CAREX ROSSII	84	<1	SALIX SPP.	29	2
FESTUCA ARIZONICA	26	<1	SWIDA SERICEA	46	2
FESTUCA BRACHYPHYLLA	42	<1	SYMPHORICARPUS OREOPHILUS	50	1
FESTUCA THURBERI	26	<1	--GRAMINOIDS--		
KOELERIA MACRANTHA	42	<1	AGROSTIS GIGANTEA	17	<1
MUHLENBERGIA MONTANA	21	<1	BROMOPSIS CILIATA	79	1
POA FENDLERIANA	58	<1	CALAMAGROSTIS CANADENSIS	17	2
--FORBS--			CAREX FOENEA	29	2
ANTENNARIA ROSEA	21	<1	GLYCERIA STRIATA	13	<1
ARTEMISIA FRANSERIOIDES	11	<1	POA FENDLERIANA	25	<1
FRAGARIA AMERICANA	26	<1	POA PRATENSIS	83	13
FRAGARIA OVALIS	16	<1	--FORBS--		
HELIANTHELLA PARRYI	11	<1	ACHILLEA MILLEFOLIUM	75	1
OREOCHRYSUM PARRYI	11	<1	CARDAMINE CORDIFOLIA	29	<1
SAXIFRAGA BRONCHIALIS	47	<1	DISPORUM TRACHYCARPUM	13	<1
SEDUM LANCEOLATUM	16	<1	EQUISETUM SPP.	17	<1
SENECIO ATRATUS	32	<1	EQUISETUM ARVENSE	38	<1
SENECIO FENDLERI	42	<1	ERIGERON EXIMIUS	29	3
VALERIANA CAPITATA	16	<1	FRAGARIA AMERICANA	50	2
			FRAGARIA OVALIS	58	<1
			GALIUM TRIFLORUM	67	3
			GERANIUM CAESPITOSUM	21	<1
			GERANIUM RICHARSONII	71	3
			HERACLEUM SPHONDYLIUM	46	1
			HIPPOCHAETE HYEMALIS	17	<1
			MERTENSIA CILIATA	33	<1
			OREOCHRYSUM PARRYI	17	<1
			OSMORHIZA DEPAUPERATA	54	<1
			PYROLA ASARIFOLIA	17	<1
			RUDBECKIA LACINIATA	46	<1
			SMILACINA RACEMOSA	29	<1
			SMILACINA STELLATA	63	3
			TARAXACUM OFFICINALE	71	<1
			THALICTRUM FENDLERI	63	3
			VIOLA CANADENSIS	67	1
			VIOLA NEPHROPHYLLA	13	<1

which typically compose greater than 80 % of the substrate. Vegetation reaches a quasi-equilibrium with the shifting substrate (Pfister et al. 1977).

ECOTONES. Since SCREE can occur in any mountainous area with unstable substrate, ecotones with any habitat type is possible.

COMMENTS. SCREE is more widespread than the small sample size of 20 plots suggests. Forest management opportunities are limited on these areas of poor site quality. SCREE is of little value for grazing or timber production. Watershed and wildlife use generally are the only sustained yield management options available for SCREE habitat types.

SCREE habitats are recognizable throughout the Rocky Mountain system. In Arizona and New Mexico, Fitzhugh et al. (1983) recognize Abies lasiocarpa, Abies concolor, and Pseudotsuga menziesii/ SCREE habitat types and a Pinus ponderosa/ROCKLAND habitat type. Shepherd (1975) describes many types identifiable as SCREE in south-central Colorado. Pfister et al. (1977) describes SCREE in Montana at the same level of generalization as presented here.

RIPARIAN Forests

GEOGRAPHY. Everywhere that streams are found within the study area, RIPARIAN forests are to be expected.

VEGETATION. Features of this type include combinations of Pinus ponderosa, Pseudotsuga menziesii, Abies concolor, Picea pungens, Abies lasiocarpa, or Picea engelmannii (the relative proportions of which is largely governed by temperature). A surplus of moisture is generally available throughout this type.

Below the Abies lasiocarpa series, Populus angustifolia generally

is the dominant broad-leaved tree (sometimes in association with Acer negundo), while Alnus tenuifolia gains dominance in the Abies lasiocarpa series. Understories are often dominated by Poa pratensis, Swida sericea, Galium triflorum, Geranium richardsonii, and Rudbeckia lanciniata (Table 5). In excess of 50 species of understory plants is not uncommon within a single 375 m-square plot in this type (Figure 33).

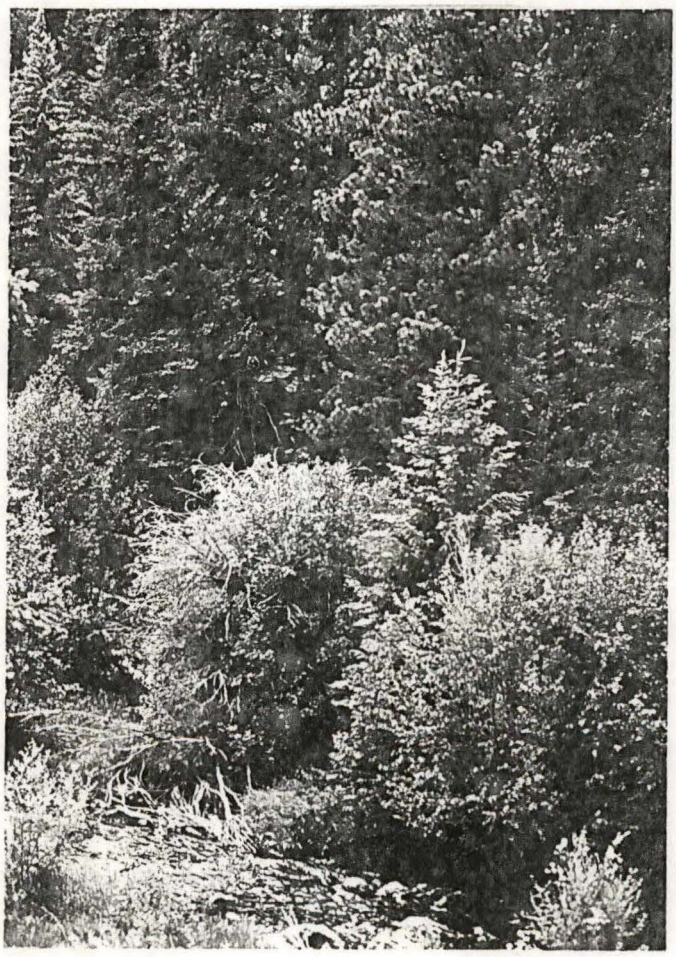

Figure 33. RIPARIAN forest in the San Juan Mountains. RIPARIAN occurs in all forest series. In this stand in the Picea pungens series 50 vascular plant species occur in the understory with a total cover in excess of 100 percent.

PHYSICAL SETTING. This type is confined to stream floodplains at all elevations. Slopes are gentle to flat. Soils vary from Typic Udifluvents or Cryofluvents to Fluventic Haploborolls.

ECOTONES. Ecotones occur with other herb-rich habitat types. Depending on elevation, it ecotones with any of Abies concolor/Acer glabrum, Picea pungens/Erigeron eximius, and Abies lasiocarpa/Erigeron eximius habitat type may be expected.

COMMENTS. RIPARIAN, being a habitat of heavily-utilized streamsides allows for the sampling of very few representative stands of the potential climax. Overgrazing, has been pervasive and many sites have been converted from species-rich to species-poor sites dominated by the introduced, grazing-resistant grass, Poa pratensis. Because of the rarity of pristine RIPARIAN areas (only 19 plots were sampled) very little is known about this widespread type. Perhaps further research would allow a clear deliniation of seperate habitat types within the RIPARIAN forests. At this time data are too few and variable to justify such division. Fluctuations in stream activity alters soil depth, depth to water table, and vegetation composition; thus adding to the difficulty in applying the climax concept to such sites (Steele et al. 1981).

Grazing potential is often high, not only due to high production of forbs and graminoids, but also because of the gentle topography and ease of access to water. Timber productivity is moderate within RIPARIAN forests. However, timber harvesting may be constrained by high water tables in some cases.

In the northern Rockies, Pfister et al. (1977) and Steele et al. (1981) recognize Bottomland hardwood forests and Floodplain communi-

ties, and Daubenmire and Daubenmire (1968) and Populus trichocarpa forest, that are representative of the type described here. Other investigators have recognized streamside habitat types within a Picea pungens series (Alexander 1981; Fitzhugh et al. 1983; Hess and Wasser 1982; Moir and Ludwig 1979), and within a Populus angustifolia series (Alexander 1981; Fitzhugh et al. 1983).

SUMMARY AND CONCLUSIONS

This study identifies and describes forest habitat types in the mountains of northern New Mexico and southern Colorado. The classification is based on 617 sample plots. Forestlands included in the study were those that support any, or a combination, of the following coniferous tree species: Pinus aristata, Abies lasiocarpa, Picea engelmannii, Picea pungens, Abies concolor, Pseudotsuga menziesii, and Pinus ponderosa.

Each habitat type is identified by its characteristic plant association. Since natural vegetation integrates all impinging environmental factors, a given habitat type encompasses a relatively narrow range of environmental variation (Daubenmire 1976). Thus, the classification presented here provides a means of delimiting land units of relatively uniform biotic potential and management opportunities. Additionally, the classification provides a common system for improving communication among diverse investigators, and is useful in improving sampling design and experimental layout.

The classification yielded 8 habitat types and 4 phases in the spruce-fir zone, 15 habitat types and 4 phases in the mixed conifer zone, and 8 habitat types and 7 phases in the ponderosa pine zone. In addition, forested scree and riparian areas were sampled. However, scree and riparian habitat types were not defined since the climax concept is difficult to apply in such unstable environments.

Successional trends varied widely among habitat types (Appendix Table A-2). In the spruce-fir zone, succession to Picea engelmannii and Abies lasiocarpa is direct in the highest (coldest) elevations, while lower elevations may exhibit any, or a combination, of Populus

tremuloides, Abies concolor, and Pseudotsuga menziesii as major seral trees. Succession in the mixed conifer zone includes Populus tremuloides, Pinus flexilis, Pinus ponderosa, and Quercus gambelii as major seral trees. Quercus gambelii is the principal seral tree of the ponderosa pine zone. More moist habitat types in the ponderosa pine zone may be regarded as fire climaxes since in the absence of fire the more shade-tolerant (but less fire-resistant) Abies concolor and Pseudotsuga menziesii may eventually dominate.

Close vegetational relationships exist among the many forest habitat types described throughout the Rocky Mountains. The most striking similarities occur within the spruce-fir zone, while habitat types in the mixed conifer and ponderosa pine zones are of relatively localized occurrence.

Considerable soil variation occurs among the habitat types described. Soil orders sampled in the study included Alfisols, Entisols, Inceptisols, and Mollisols. Soil moisture-temperature regimes varied from udic-cryic in the spruce-fir zone to ustic-frigid in the ponderosa pine zone.

Field identification of habitat types is accomplished through use of a dichotomous key. Ideally, since the classification was developed using mature, minimally-disturbed forest, identification of habitat type using the keys and descriptions given is best acheived through examining near-pristine vegetation.

This study does not purport to describe all the forest habitat types of northern New Mexico and southern Colorado. Refinement of the classification will take place following field evaluation of the keys and descriptions.

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APPENDIX

Table A-1. Plant list - species observations (OBS) in forest stands of northern New Mexico and southern Colorado (nomenclature follows Weber and Johnston (1979)).

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
- - T R E E S - -			
ABIES CONCOLOR - YOUNG REGEN.	ABCO1	184	
ABIES CONCOLOR - ADV. REGEN..	ABCO2	169	
ABIES CONCOLOR - MATURE	ABCO3	124	
ABIES LASIOCARPA - YNG. REGEN.	ABLA1	235	
ABIES LASIOCARPA - ADV. REGEN.	ABLA2	222	
ABIES LASIOCARPA - MATURE	ABLA3	169	
ACER GLABRUM - REGENER	ACGL1	30	
ACER GLABRUM - ADV. REGEN.	ACGL2	14	
ACER GLABRUM - MATURE	ACGL3	0	
ACER NEGUNDO - YNG REGEN.	ACNE1	2	
ACER NEGUNDO - ADV. REGEN.	ACNE2	2	
ACER NEGUNDO - MATURE	ACNE3	2	
ALNUS SPP. - REGENER	ALNUS1	6	
ALNUS TENUIFOLIA - YNG REGEN	ALTE1	5	
ALNUS TENUIFOLIA - ADV REGEN	ALTE2	5	
ALNUS TENUIFOLIA - MATURE	ALTE3	0	
FORESTIERA NEOMEXICANA-YNG REG	FONE1	1	
FORESTIERA NEOMEXICANA-ADV REG	FONE2	1	
FORESTIERA NEOMEXICANA-MATURE	FONE3	0	
FRAXINUS SPP. - ADV. REGEN	FRAX2	1	
FRAXINUS ANOMALA - YNG. REGEN	FRAN1	1	
JUNIPERUS MONOSPERMA-YNG REGEN	JUMO1	45	
JUNIPERUS MONOSPERMA-ADV REGEN	JUMO2	19	
JUNIPERUS MONOSPERMA-MATURE	JUMO3	4	
JUNIPERUS OSTEOSPERMA-YNG REG	JUOS1	2	JUNIPERUS UTAHENSIS
JUNIPERUS OSTEOSPERMA-ADV REG	JUOS2	3	JUNIPERUS UTAHENSIS
JUNIPERUS OSTEOSPERMA-MATURE	JUOS3	0	JUNIPERUS UTAHENSIS
JUNIPERUS SCOPULORUM-YNG REGEN	JUSC1	81	
JUNIPERUS SCOPULORUM-ADV REGEN	JUSC2	55	
JUNIPERUS SCOPULORUM- MATURE	JUSC3	14	
PICEA ENGELMANNII - YNG REGEN	PIEN1	250	
PICEA ENGELMANNII - ADV REGEN	PIEN2	254	
PICEA ENGELMANNII - MATURE	PIEN3	231	
PICEA PUNGENS - YNG REGEN	PIPU1	86	
PICEA PUNGENS - ADV REGEN	PIPU2	87	
PICEA PUNGENS - MATURE	PIPU3	65	
PINUS ARISTATA - YNG REGEN	PIAR1	19	
PINUS ARISTATA - ADV REGEN	PIAR2	18	
PINUS ARISTATA - MATURE	PIAR3	16	
PINUS CONTORTA - YNG REGEN	PICO1	3	
PINUS CONTORTA - ADV REGEN	PICO2	5	
PINUS CONTORTA - MATURE	PICO3	3	
PINUS EDULIS - YNG REGEN	PIED1	99	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
PINUS EDULIS - ADV REGEN	PIED2	61	
PINUS EDULIS - MATURE	PIED3	8	
PINUS FLEXILIS - YNG REGEN	PIFL1	103	INCLUDES P. F. X STROBIFORMIS
PINUS FLEXILIS - ADV REGEN	PIFL2	77	INCLUDES P. F. X STROBIFORMIS
PINUS FLEXILIS - MATURE	PIFL3	49	INCLUDES P. F. X STROBIFORMIS
PINUS PONDEROSA - YNG REGEN	PIPO1	200	
PINUS PONDEROSA - ADV REGEN	PIPO2	228	
PINUS PONDEROSA - MATURE	PIPO3	259	
POPULUS ANGUSTIFOLIA-YNG REGEN	POAN1	8	
POPULUS ANGUSTIFOLIA-ADV REGEN	POAN2	8	
POPULUS ANGUSTIFOLIA-MATURE	POAN3	13	
POPULUS TREMULOIDES-YNG REGEN	POTR1	113	
POPULUS TREMULOIDES-ADV REGEN	POTR2	128	
POPULUS TREMULOIDES-MATURE	POTR3	46	
PSEUDOTSUGA MENZIESII-YNG REG	PSME1	269	
PSEUDOTSUGA MENZIESII-ADV REG	PSME2	266	
PSEUDOTSUGA MENZIESII- MATURE	PSME3	244	
QUERCUS GAMBELII - YNG REGEN	QUGA1	97	
QUERCUS GAMBELII - ADV REGEN	QUGA2	54	
QUERCUS GAMBELII - MATURE	QUGA3	2	
QUERCUS GAMBELII X GRISEA REG	QUGAR1	2	Q. UNDULATA
QUERCUS GRISEA-YNG. REGEN	QUGR1	1	
QUERCUS GRISEA-ADV. REGEN	QUGR2	0	
QUERCUS GRISEA-MATURE	QUGR3	0	
ROBINIA NEOMEXICANA-YNG REGEN	RONE1	5	
SALIX SCOULERIANA - YNG REGEN	SASC1	10	
SALIX SCOULERIANA - ADV REGEN	SASC2	6	
SALIX SCOULERIANA - MATURE	SASC3	1	
- - S H R U B S - -			
ACER GLABRUM	ACGL	104	
ACER NEGUNDO	ACNE	5	
ALNUS SPP.	ALNUS	10	
ALNUS TENUIFOLIA	ALTE	8	
AMELANCHIER ALNIFOLIA	AMAL	107	
AMELANCHIER GOLDMANNII	AMGO	1	
AMELANCHIER UTAHENSIS	AMUT	15	
AMORPHA CANESCENS	AMCA	15	
ARCTOSTAPHYLOS UVA-URSI	ARUV	95	
ARTEMESIA TRIDENTATA	ARTR	5	
BERBERIS FENDLERI	BEFE	23	
CEANOTHUS FENDLERI	CEFE	40	
CERCOCARPUS MONTANUS	CEMO	97	
CHIMAPHILA UMBELLATA	CHUM	12	
CHRYSOTHAMNUS DEPRESSUS	CHDE	6	
CHRYSOTHAMNUS GREENEI	CHGR	3	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
CHRYSOTHAMNUS NAUSEOSUS	CHNA	27	
CHRYSOTHAMNUS VISCIDIFLORUS	CHVI	3	
CLEMATIS COLUMBIANA	CLCO	115	C. PSEUDOALPINA
CLEMATIS HIRSUTISSIMA	CLHI	10	
CLEMATIS LIGUSTICIFOLIA	CLLI	7	
FALLUGIA PARADOXA	FAPA	3	
FENDLERA RUPICOLA	FERU	1	
FORESTIERA NEOMEXICANA	FONE	4	
FRAXINUS ANOMALA	FRAN	2	
GAULTHERIA HUMIFUSA	GAHU	1	
HOLODISCUS DUMOSUS	HODU	31	
HYMENOXYS ACAULIS	HYAC	43	
HYMENOXYS RICHARDSONII	HYRI	46	
JAMESIA AMERICANA	JAAM	48	
JUNIPERUS COMMUNIS	JUCO	188	
JUNIPERUS SCOPULORUM	JUSC	6	
LINNAEA BOREALIS	LIBO	55	
LONICERA INVOLUCRATA	LOIN	150	
MAHONIA REPENS	MARE	180	BERBERIS REPENS
NOLINA MICROCARPA	NOMI	3	
PACHISTIMA MYRSINITES	PAMY	204	
PENTAPHYLLOIDES FLORIBUNDA	PEFL	13	POTENTILLA FRUTICOSA
PHILADELPHUS SPP.	PHILA	1	
PHYSOCARPUS MONOGYNUS	PHMO	26	
PINUS EDULIS - SHRUBS	PIED	1	
POLIOMINTHA INCANA	POINC	1	
POPULUS ANGUSTIFOLIA	POAN	2	
POPULUS TREMULOIDES - SHRUBS	POTR	169	
PRUNUS SPP.	PRUNUS	1	
PRUNUS VIRGINIANA	PRVI	66	
PURSHIA TRIDENTATA	PUTR	11	
QUERCUS GAMBELII	QUGA	195	
QUERCUS GAMBELII X GRISEA	QUGAGR	26	Q. UNDULATA
QUERCUS GRISEA X GAMBELII	QUGRGA	16	Q. UNDULATA
QUERCUS GRISEA	QUGR	9	
RHUS AROMATICA	RHAR	33	RHUS TRILOBATA
RIBES SPP.	RIBES	3	
RIBES CEREUM	RICE	66	
RIBES INERME	RIIN	47	
RIBES MONTIGENUM	RIMO	129	
RIBES PINETORUM	RIPI	3	
RIBES VISCOSISSIMUM	RIVI	1	
RIBES WOLFII	RIWO	68	
ROBINIA NEOMEXICANA	RONE	20	
ROSA SPP.	ROSA	257	
ROSA WOODSII	ROWO	7	R. FENDLERI

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
RUBUS DELICIOSUS	RUDE	5	
RUBUS NEOMEXICANUS	RUNE	2	
RUBUS PARVIFLORUS	RUPA	108	
RUBUS IDAEUS VAR. STRIGOSUS	RUID	41	RUBUS STRIGOSUS
SALIX SPP.	SALIX	25	
SALIX DEPRESSA	SADE	1	S. BEBBIANA
SALIX SCOULERIANA	SASC	47	
SALIX SUBCOERULEA	SASU	1	
SAMBUCUS SPP.	SAMBUC	13	
SAMBUCUS RACEMOSA	SARA	33	
SHEPHERDIA CANADENSIS	SHCA	88	
SORBUS SPP.	SORBUS	8	
SORBUS SCOPULINA	SOSC	9	
SWIDA SERICEA	SWSE	29	CORNUS STOLINIFERA
SYMPHORICARPUS OREOPHILUS	SYOR	235	
TOXICODENDRON RYDBERGII	TORY	13	T. (RHUS) RADICANS
VACCINIUM CESPITOSUM	VACE	7	V. CAESPITOSUM
VACCINIUM SPP.	VAMY	221	V. (OREOPHILUM) MYRTILLUS
XANTHOCEPHALUM SAROTHRAE	XASA	27	GUTIERREZIA SAROTHRAE
YUCCA BACCATA	YUBA	17	
YUCCA GLAUCA	YUGL	24	
--GRAMINOIDS--			
AGROPYRON (SMITHII?)	AGROPY	5	
AGROPYRON DESERTORUM	AGDE	1	
AGROPYRON ELONGATUM	AGEL	2	
AGROPYRON SMITHII	AGSM	16	
AGROPYRON SUBSECUNDUM	AGSU	10	
AGROPYRON TRACHYCAULUM	AGTR	19	
AGROSTIS SPP.	AGROST	4	
AGROSTIS GIGANTEA	AGGI	8	A. ALBA
AGROSTIS SCABRA	AGSC	17	
ANDROPOGON GERARDI	ANGE	34	
ARISTIDA SPP.	ARISTI	1	
ARISTIDA ARIZONICA	ARAR	10	
ARISTIDA FENDLERIANA	ARFE	19	
ARISTIDA LONGISETA	ARLO	8	
BLEPHARONEURON TRICHOLEPIS	BLTR	64	
BOUTELOUA CURTIPENDULA	BOCU	29	
BOUTELOUA GRACILIS	BOGR	67	
BOUTELOUA HIRSUTA	BOHI	6	
BROMOPSIS CILIATA	BRCI	333	BROMUS (RICHARDSONI) CILIATUS
BROMOPSIS LANATIPES	BRLA	23	BROMUS LANATIPES
BROMOPSIS PORTERI	BRPOR	5	BROMUS ANOMALOUS
BROMUS SPP.	BROMUS	16	
BROMUS POLYANTHUS	BRPO	2	
BROMUS TECTORUM	BRTE	5	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
CALAMAGROSTIS CANADENSIS	CACA	19	
CALAMAGROSTIS INEXPANSA	CAIN	2	
CALAMAGROSTIS PURPURASCENS	CAPU	1	
CAREX SPP.	CAREX	100	
CAREX AUREA	CAAU	1	
CAREX BELLA	CABE	17	
CAREX BREVIPES	CABR	4	
CAREX DEWEYANA	CADE	3	
CAREX EBENEA	CAEB	2	
CAREX ELYNOIDES	CAELY	2	
CAREX FESTIVELLA	CAFE	1	
CAREX FOENEA	CAFO	85	
CAREX GEOPHILA	CAGE	5	
CAREX GEYERI	CAGEY	48	
CAREX HELIOPHILA	CAHE	25	
CAREX LANUGINOSA	CALA	1	
CAREX MICROPTERA	CAMI	11	
CAREX NORVEGICA SSP. STEVENII	CANOR	2	C. MEDIA
CAREX NOVA	CANO	1	
CAREX OCCIDENTALIS	CAOC	13	
CAREX PRAEGRACILIS	CAPR	2	
CAREX ROSSII	CARO	277	
CAREX RUPESTRIS	CARU	1	
CAREX SCOPULORUM	CASC2	1	
CAREX STENOPHYLLA S. ELEOCH.	CAST	1	C. ELEOCHARIS
CAREX UTRICULATA	CAUT	2	C. ROSTRATA
CAREX VALLICOLA	CAVA	1	
CYPERUS FENDLERIANUS	CYFE	1	
DANTHONIA INTERMEDIA	DAIN	2	
DANTHONIA PARRYI	DAPA	38	
DESCHAMPSIA CAESPITOSA	DECA	13	
DICHANTHELIUM LANUGINOSUM	DILA	4	PANICUM HUACHUCAE
ELYMUS SPP.	ELYMUS	7	
ELYMUS AMBIGUUS	ELAM	1	
ELYMUS CANADENSIS	ELCA	3	
ELYMUS GLAUCUS	ELGL	30	
ERAGROSTIS SPP.	ERAGRO	1	
ERAGROSTIS INTERMEDIA	ERIN	1	
FESTUCA ARIZONICA	FEAR	150	
FESTUCA BRACHYPHYLLA	FEBR	22	F. OVINA
FESTUCA SORORIA	FESO	28	
FESTUCA THURBERI	FETH	48	
GLYCERIA ELATA	GLEL	1	
GLYCERIA STRIATA	GLST	4	
HILARIA JAMESII	HIJA	1	
JUNCUS ARCTICUS	JUAR	3	J. BALTICUS

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
JUNCUS DRUMMONDII	JUDR	1	
JUNCUS LONGISTYLIS	JULO	2	
JUNCUS PARRYI	JUPA	3	
KOELERIA MACRANTHA	KOMA	253	K. CRISTATA
LEUCOPOA KINGII	LEKI	1	
LUZULA PARVIFLORA	LUPA	75	
LUZULA SPICATA	LUSP	1	
LYCURUS PHLEOIDES	LYPH	5	
MARISCUS SCHWEINITZII	MASC	2	CYPERUS SCHWEINITZII
MELICA PORTERI	MEPO	7	
MUHLENBERGIA SPP.	MUHLEN	3	
MUHLENBERGIA EMERSLEYI	MUEM	1	
MUHLENBERGIA MONTANA	MUMO	185	
MUHLENBERGIA MONTICOLA	MUMO1	2	
MUHLENBERGIA PUNGENS	MUPU	1	
MUHLENBERGIA RACEMOSA	MURA	3	
MUHLENBERGIA RIGENS	MURI	3	
MUHLENBERGIA VIRESCENS	MUVI	2	
MUHLENBERGIA WRIGHTII	MUWR	1	
ORYZOPSIS SPP.	ORYZOP	12	
ORYZOPSIS ASPERIFOLIA	ORAS	51	
ORYZOPSIS HYMENOIDES	ORHY	15	
ORYZOPSIS MICRANTHA	ORMI	21	
PANICUM SP.	PANICU	1	
PANICUM OBTUSUM	PAOB	1	
PANICUM VIRGATUM	PAVI	3	
PHLEUM COMMUTATUM	PHCO	7	P. ALPINUM
PHLEUM PRATENSIS	PHPR	7	
PIPTOCHAETIUM FIMBRIATUM	PIFI	1	
POA SPP.	POA	7	
POA ALPINA	POALP	6	
POA ARTICA SSP GRAYANA	POAR	1	
POA COMPRESSA	POCO	2	
POA EPILIS	POEP	1	
POA FENDLERIANA	POFE	303	
POA GLAUCA VAR. RUPICOLA	POGL	3	P. RUPICOLA
POA LEPTOCOMA	POLE	13	
POA NEMORALIS V. INTERIOR	PONEM	18	POA INTERIOR
POA NERVOSA VAR TRACYI	PONE	1	
POA PALUSTRIS	POPA	1	
POA PRATENSIS	POPR	74	
POA REFLEXA	PORE	13	
SCHIZACHNE PURPURASCENS	SCPU	5	
SCHIZACHYRIUM SCOPARIUM	SCSC	72	ANDROPOGON SCOPARIUS
SITANION HYSTRIX	SIHY	209	S. LONGIFOLIUM
SORGHASTRUM AVENACEUM	SOAV	16	S. NUTANS

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
SPOROBOLUS CRYPTANDRUS	SPCR	7	
SPOROBOLUS GIGANTEUS	SPGI	1	
STIPA SPP	STIPA	10	
STIPA COMATA	STCOM	19	
STIPA OCCIDENTALIS	STOC	5	S. COLUMBIANA
STIPA PRINGLEI	STPR	2	
STIPA ROBUSTA	STRO	1	
TRISETUM SPICATUM	TRSP	14	
TRISETUM SPICATUM S. MONTANUM	TRSPMO	134	T. MONTANUM
TRISETUM WOLFII	TRWOL	2	
- - F O R B S - -			
ABRONIA SPP.	ABRONI	1	
ACHILLEA MILLEFOLIUM	ACMI	186	SSP. LANULOSA A. LANULOSA
ACOMASTYLIS ROSSII	ACRO	8	GEUM ROSSII
ACONITUM COLUMBIANUM	ACCO	11	
ACTAEA RUBRA SSP. ARGUTA	ACRU	65	A. ARGUTA
AGASTACHE PALLIDIFLORA	AGPA	1	
AGERATINA HERBACEA	AGHE	8	EUPATORIUM HERBACEUM
AGOSERIS AURANTIACA	AGAU	6	
AGOSERIS GLAUCA	AGGL	2	
AGRIMONIA STRIATA	AGST	3	
ALLIUM SPP	ALLIUM	4	
ALLIUM CERNUUM	ALCE	103	
ALLIUM GEYERI	ALGE	8	
AMBROSIA SPP.	AMBROS	1	
ANDROSACE SEPTENTRIONALIS	ANSE	63	
ANEMONE SPP.	ANEMON	1	
ANEMONE CANADENSIS	ANCA	1	
ANGELICA GRAYII	ANGR	23	
ANTENNARIA SPP.	ANTENN	37	
ANTENNARIA NEGLECTA	ANNE	47	A. MARGINATA
ANTENNARIA PARVIFOLIA	ANPA	2	ANTENNARIA APRICA
ANTENNARIA ROSEA	ANRO	169	
ANTICLEA ELEGANS	ANEL	75	ZYGADENUS ELEGANS
APOCYNUM SPP.	APOCYN	31	
APOCYNUM ANDROSAEMIFOLIUM	APAN	19	
AQUILEGIA SPP	AQUILE	13	
AQUILEGIA CAERULEA	AQCA	55	
AQUILEGIA CHRYSANTHA	AQCH	1	
AQUILEGIA ELEGANTULA	AQEL	81	
ARABIS SPP.	ARABIS	63	
ARABIS DRUMMONDII	ARDRU	23	
ARABIS FENDLERI	ARAFE	57	
ARALIA SPP.	ARALIA	1	
ARALIA NUDICAULIS	ARNU	1	
ARCTIUM MINUS	ARMI	1	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
ARENARIA SPP	ARENAR	10	
ARENARIA FENDLERI	AREFE	39	
ARENARIA LANUGINOSA	ARLAN	8	A. (CONFUSA) SAXOSA
ARNICA SPP.	ARNICA	16	
ARNICA CORDIFOLIA	ARCO	149	
ARNICA LATIFOLIA	ARLA	5	
ARNICA MOLLIS	ARMO	10	
ARTEMISIA SPP.	ARTEMI	2	
ARTEMISIA CAMPESTRIS S. PAC.	ARCAM	4	A. PACIFICA
ARTEMISIA CARRUTHII	ARCA	52	
ARTEMISIA DRACUNCULOIDES	ARDR	17	
ARTEMISIA FRANSERIOIDES	ARFR	139	
ARTEMISIA FRIGIDA	ARFRI	31	
ARTEMISIA LUDOVICIANA	ARLU	141	
ARTEMISIA PARRYI	ARPAR	1	
ARTEMISIA SCOPULORUM	ARSC	2	
ASCLEPIAS SPP.	ASCLEP	1	
ASCLEPIAS ASPERULA	ASAS	1	A. CAPRICORNA
ASCLEPIAS TUBEROSA	ASTU	1	
ASCLEPIAS VIRIDIFLORA	ASVI	2	
ASPARAGUS OFFICINALIS	ASOF	1	
ASTER SPP.	ASTER	9	
ASTER FOLIACEUS	ASFO	1	
ASTER GLAUCODES	ASGL	7	
ASTER LAEVIS	ASLA	6	
ASTRAGALUS SPP.	ASTRAG	4	
ASTRAGALUS ADSURGENS	ASAD	2	
ASTRAGALUS DRUMMONDII	ASDR	1	
ASTRAGALUS FLEXUOSUS	ASFL	8	
ASTRAGALUS HUMISTRATUS	ASHU	1	
ASTRAGALUS LONCHOCARPUS	ASLO	1	
ASTRAGALUS PARRYI	ASPA	1	
ASTRAGALUS TENELLUS	ASTE	1	
ASTRAGALUS WINGATANUS	ASWI	1	
BAHIA DISSECTA	BADI	34	
BALSAMORHIZA SAGITTATA	BASA	2	
BATRACHIUM TRICHOPYLLUS	BATR	1	RANUNCULUS TRICHOPHYLLUS
BESSEYA PLANTAGINEA	BEPL	6	
BIDENS BIPINNATA	BIBI	2	
BISTORTA BISTORTOIDES	BIBIS	11	POLYGONUM BISTORTOIDES
BISTORTA VIVIPARA	BIVI	13	POLYGONUM VIVIPARUM
BRICKELLIA SPP.	BRICKE	15	
BRICKELLIA BRACHYPHYLLA	BRBR	2	
BRICKELLIA GRANDIFLORA	BRGR	30	
BRICKELLIA MICROPHYLLA	BRMI	1	B. SCABRA
CALOCHORTUS GUNNISONII	CAGU	7	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
CALTHA LEPTOSEPALA	CALE	16	
CALYPSO BULBOSA	CABU	19	
CAMPANULA ROTUNDIFOLIA	CAROT	118	
CARDAMINE CORDIFOLIA	CACO	24	
CASTILLEJA SPP.	CASTIL	19	
CASTILLEJA INTEGRA	CAINT	3	
CASTILLEJA LINARIAEFOLIA	CALI2	17	
CASTILLEJA LINEATA	CALI	8	
CASTILLEJA MINIATA	CAMIN	33	
CASTILLEJA OCCIDENTALIS	CASOC	2	
CASTILLEJA RHEXIFOLIA	CARH	6	
CASTILLEJA SULPHUREA	CASU	2	
CERASTIUM SPP.	CERAST	2	
CERASTIUM ARVENSE	CEAR	5	
CHAENACTIS SPP.	CHAENA	2	
CHAENACTIS DOUGLASII	CHDO	6	
CHAMAEPERICLYMENUM CANADENSE	CHCA	1	CORNUS CANADENSIS
CHAMAESYCE ALBOMARGINATA	CHAMAL	1	EUPHOBIA ALBOMARGINATA
CHAMAESYCE FENDLERI	CHAFE	2	EUPHOBIA FENDLERI
CHAMERION ANGUSTIFOLIUM	CHAN	137	EPILOBIUM ANGUSTIFOLIUM
CHEILANTHES SPP.	CHEILA	6	
CHEILANTHES FENDLERI	CHFE	7	
CHENOPODIUM SPP.	CHENOP	8	
CHENOPODIUM AFF ALBUM	CHAL	12	
CHENOPODIUM FREMONTII	CHFR	6	
CHENOPODIUM GRAVEOLENS	CHIN	2	
CICUTA DOUGLASII	CIDO	2	
CIRCAEA ALPINA	CIAL	2	
CIRSIUM SPP	CIRSIU	42	
CIRSIUM CANESCENS	CICA	1	
CIRSIUM PALLIDUM	CIPAL	1	
CIRSIUM PARRYI	CIPA	10	
CIRSIUM SCOPULORUM	CISC	2	
CIRSIUM UNDULATUM	CIUN	1	
CLEMENTSIA RHODANTHA	CLRH	3	SEDUM RHODANTHUM
COELOGLOSSUM VIRIDE	COVI	1	S. BRACEATUM (HABENARIA VIRIDUS)
COMANDRA UMBELLATA S. PALLIDA	COUM	31	C. PALLIDA
COMMELINA DIANTHIFOLIA	CODI	2	
CONIOSELINUM SCOPULORUM	COSCO	1	
CONOPHOLIS MEXICANA	COME	2	
CONYZA CANADENSIS	CONCA	1	
CONYZA SCHIEDEANA	COSC	1	
CORALLORHIZA SPP	CORALL	10	
CORALLORHIZA MACULATA	COMA	51	
CORALLORHIZA STRIATA	COSTR	11	
CORALLORHIZA TRIFIDA	COTR	2	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
COREOPSIS LANCEOLATA	COLA	1	
CORYDALIS AUREA	COAU	1	
CORYDALIS CASEANA	COCAS	2	
CORYPHANTUS SPP.	CORYPH	1	
COSMOS PARVIFLORA	COPA	2	
CREPIS SPP.	CREPIS	2	
CRYPTANTHA JAMESII	CRJA	9	
CRYPTANTHA THYRSIFLORA	CRTH	3	
CRYPTOGRAMMA CRISPA	CRCR	2	
CYNOGLOSSUM OFFICINALE	CYNOGL	4	
CYPRIPEDIUM CALCEOLUS	CYCA	1	
CYSTOPTERIS FRAGILIS	CYFR	40	
DALEA SPP.	DALEA	1	
DALEA CANDIDA V. OLIGOPHYLLA	DACAN	4	PETALOSTEMOM CANDIDUS
DALEA PURPUREA	DAPU	8	PETALOSTEMOM PURPUREA
DELPHINIUM SPP.	DELPHI	1	
DELPHINIUM BARBEYI	DEBA	29	
DESCURAINIA SPP	DESC	2	
DESCURAINIA RICHARDSONII	DERI	12	
DISPORUM TRACHYCARPUM	DITR	28	
DITHYREA WISLIZENI	DIWI	1	
DODECATHEON PULCHELLUM	DOPU	1	
DODECATHEON ELLISIAE	DOEL	2	
DRABA SPP.	DRABA	32	
DRABA AUREA	DRAU	26	
DRABA HELLERIANA	DRHE	33	
DRABA SMITHII	DRSM	1	
DRABA SPECTABILIS	DRSP	2	
DRABA STREPTOCARPA	DRST	19	
DRYMOCALLIS FISSA	DRFIS	10	POTENTILLA FISSA
DRYOPTERIS FILIX-MAS	DRFI	1	
DUGALDIA HOOPESII	DUHO	15	HELENIUM HOOPSII
ECHINOCEREUS SPP.	ECHINO	18	
ECHINOCEREUS FENDLERI	ECFE	1	
ECHINOCEREUS VIRIDIFLORUS	ECVI	2	
EPILOBIUM SPP.	EPILOB	19	
EPILOBIUM ADENOCAULON	EPAD	3	
EPILOBIUM CILIATUM	EPCI	3	E. GLANDULOSUM
EPILOBIUM HORNEMANNII	EPHO	8	
EQUISETUM SPP.	EQUISE	5	
EQUISETUM ARVENSE	EQAR	15	
ERIGERON SPP.	ERIGER	17	
ERIGERON CANUS	ERCAN	1	
ERIGERON COMPOSITUS	ERCOM	2	
ERIGERON CONCINNUS	ERCO	22	
ERIGERON COULTERI	ERCOU	14	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
ERIGERON DIVERGENS	ERDI	5	
ERIGERON FLAGELLARIS	ERFL	90	
ERIGERON FORMOSISSIMUS	ERFO	63	
ERIGERON MELANOCEPHALUS	ERME	4	
ERIGERON ELATIOR	EREL	1	
ERIGERON PEREGRINUS	ERPE	32	
ERIGERON PLATYPHYLLUS	ERPL	1	
ERIGERON SPECIOSUS V SPECIOSUS	ERSP	25	
ERIGERON SUBTRINERVIS	ERSUB	72	
ERIGERON VETENSIS	ERVE	10	
ERIGERON EXIMIUS	EREX	221	E. SUPERBUS
ERIOGONUM ALATUM	ERAL	46	
ERIOGONUM ANNUUM	ERAN	1	
ERIOGONUM BAKERI	ERBA	1	
ERIOGONUM JAMESII	ERJA	36	
ERIOGONUM MICROTHECUM	ERMI	3	
ERIOGONUM RACEMOSUM	ERRA	32	
ERIOGONUM UMBELLATUM	ERUM	7	
ERYSIMUM SPP	ERYSIM	3	
ERYSIMUM ASPERUM	ERAS	1	
ERYSIMUM CAPITATUM	ERCA	52	
ERYTHRONIUM GRANDIFLORUM	ERGR	8	
EUPHORBIA SPP.	EUPHOR	2	
EUPHORBIA ROBUSTA	EURO	5	
FRAGARIA AMERICANA	FRAM	122	FRAGARIA VESCA VAR BRACTEATA
FRAGARIA OVALIS	FROV	301	FRAGARIA VIRGINIANA VAR GLAUCA
FRASERA SPECIOSA	FRSP	38	SWERTIA RADIATA
GAILLARDIA ARISTATA	GAAR	1	
GAILLARDIA PINNATIFIDA	GAPI	1	
GALIUM SPP.	GALIUM	5	
GALIUM APARINE	GAAP	6	
GALIUM BOREALE	GABO	55	
GALIUM TRIFIDUM	GATR2	45	
GALIUM TRIFLORUM	GATR	51	
GAURA SPP.	GAURA	2	
GAURA NEOMEXICANA	GANE	1	
GAYOPHYTUM DIFFUSUM	GADI	1	SSP. PARVIFLORUM (G. NUTTALLII)
GENTIANA SPP	GENTIA	6	
GENTIANELLA AMARELLA S. ACUTA	GEAMAC	25	GENTIANA (PLEBEJA) STRICTIFLORA
GENTIANELLA AMARELLA	GEAMHE	23	SSP. HETEROSEPALA (GENTIANA HET.)
GENTIANELLA AMARELLA	GEAM	2	
GERANIUM SPP.	GERANI	7	
GERANIUM CAESPITOSUM	GECA	91	G. FREMONTII
GERANIUM RICHARSONII	GERI	184	
GEUM ALEPPICUM SSP. STRICTUM	GEAL	3	G. STRICTUM
GEUM MACROPHYLLUM	GEMA	3	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
GILIA SPP.	GILIA	2	
GILIA PINNATIFIDA V. CALCAREA	GIPI	9	
GNAPHALIUM SPP.	GNAPHA	4	
GNAPHALIUM VISCOSUM	GNVI	6	G. MACOUNII
GNAPHALIUM WRIGHTII	GNWR	1	
GOODYERA OBLONGIFOLIA	GOOB	137	
GOODYERA REPENS	GORE	15	
HABENARIA SPP.	HABENA	5	
HACKELIA SPP.	HACKEL	4	
HACKELIA FLORIBUNDA	HAFL	3	
HARBOURIA TRACHYPLEURA	HATR	19	
HEDEOMA DRUMMONDII	HEDR	1	
HELIANTHELLA PARRYI	HEPA	46	
HELIANTHELLA QUINQUENERVIS	HEQU	2	
HELIANTHUS ANNUUS	HEAN	1	
HELIOMERIS MULTIFLORA	HEMU	26	VIGUIERA MULTIFLORA
HELIOPSIS HELIANTHOIDES	HEHE	1	V. SCABRA (H. SCABRA)
HERACLEUM SPHONDYLIUM	HESP	32	H. LANATUM
HERRICKIA HORRIDA	HEHOR	2	ASTER HORRIDUS
HETEROTHECA FULCRATA	HEFU	123	CHRYSOPSIS VILLOSA V. FOLIOSA
HEUCHERA SPP.	HEUCHE	20	
HEUCHERA PARVIFOLIA	HEUPA	9	
HIERACIUM SPP.	HIERAC	6	
HIERACIUM FENDLERI	HIFE	38	
HIERACIUM GEYERI	HIGE	1	
HIERACIUM GRACILE	HIGR	9	
HIPPOCHAETE HYEMALIS	HIHY	5	EQUISETUM HIEMALIS
HIPPOCHAETE LAEVIGATA	HILA	2	EQUISETUM LAEVIGATUM
HUMULUS LUPULUS	HULU	1	
HYDROPHYLLUM FENDLERI	HYFE	17	
HYMENOPAPPUS FILIFOLIUS	HYFIPR	2	VAR. PARVULUS (H. LUGENS)
HYMENOPAPPUS RADIATUS	HYRA	8	
HYMENOXYS SPP.	HYMENX	5	
HYMENOXYS GRANDIFLORA	HYGR	1	
HYPERICUM FORMOSUM	HYFO	1	
IPOMOEA COCCINEA	IPCOC	1	
IPOMOPSIS AGGREGATA	IPAG	88	GILIA AGGREGATA
IRIS MISSOURIENSIS	IRMI	23	
KRASCHENINNIKOVIA LANATA	KRLA	5	EUROTIA (CERATOIDES) LANATA
KUHNIA ROSMARINIFLOLIA	KURO	1	V. CHLOROLEPIS (K. CHLOROLEPIS)
LACTUCA SERRIOLA	LASE	2	L. SCARIOLA
LAPPULA SPP	LAPPUL	1	
LAPPULA REDOWSKII	LARE	2	
LATHYRUS SPP.	LATHYR	1	
LATHYRUS SP.	LAAR	201	L. ARIZONICUS
LATHYRUS ARIZ. X GRAMINI.	LAARGR	1	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
LATHYRUS GRAMINIFOLIUS	LAGR	7	
LEONURUS CARDIACA	LECA	1	
LEPIDIUM SPP.	LEPIDI	4	
LEPIDIUM VIRGINICUM	LEVI	1	
LEPTODACTYLON PUNGENS	LEPU	1	
LESQUERELLA SP.	LESQUE	1	
LESQUERELLA ALPINA	LEAL	1	L. SUBUMBELLATA
LESQUERELLA FENDLERI	LEFE	14	
LESQUERELLA MONTANA	LESMO	6	
LEUCANTHEMUM VULGARE	LEVU	1	CHRYSANTHEMUM LEUCANTHEMUM
LEUCELENE ERICOIDES	LEER	2	
LIATRUS PUNCTATA	LIPU	17	
LIGULARIA AMPLECTENS	LIAM	39	SENECIO AMPLECTENS
LIGULARIA BIGELOVII	LIBI	11	SENECIO BIGELOVII
LIGULARIA PUDICA	LIPUD	2	SENECIO PUDICUS
LIGUSTICUM PORTERI	LIPO	108	
LIMNORCHIS SACCATA	LISA	3	HABENARIA SACCATA
LINATHUS NUTTALLII	LINU	1	LINANTHASTRUM NUTTALLII
LINUM SPP. (ANNUALS)	LINUM	4	
LINUM ARISTATUM	LIAR	1	
LISTERA CORDATA	LICO	21	
LITHOSPERMUM MULTIFLORUM	LIMU	118	
LOTUS WRIGHTII	LOWR	32	
LUPINUS SPP.	LUPINU	11	
LUPINUS ARGENTEUS	LUAR	36	
LUPINUS KINGII	LUKI	4	
MACROMERIA VIRIDIFLORA	MAVI	2	
MAMMALARIA SPP	MAMMAL	12	
MEDICAGO LUPULINA	MEDLU	1	
MELAMPODIUM CINEREUM	MECI	2	
MELILOTUS ALBA	MEAL	2	
MELILOTUS OFFICINALIS	MEOF	3	
MENTHA ARVENSIS	MEAR	8	
MENTZELIA PUMILA	MEPU	2	
MERTENSIA SPP.	MERTEN	7	
MERTENSIA CILIATA	MECIL	96	
MERTENSIA FRANCISCANA	MEFR	24	
MERTENSIA LANCEOLATA	MELA	36	
MERTENSIA VIRIDUS	MEVI	3	
MIMULUS GUTTATUS	MIGU	4	
MITELLA PENTANDRA	MIPE	24	
MOEHRINGIA MACROPHYLLA	MOMA	7	ARENARIA MACROPHYLLA
MONARDA FISTULOSA V. MENTHAE.	MOFI	4	M. MENTHAEFOLIA
MONESES UNIFLORA	MOUN	75	PYROLA UNIFLORA
MONOTROPA LATISQUAMA	MOLA	6	
OENOTHERA CAESPITOSA	OECA	9	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
OENOTHERA CORONOPIFOLIA	OECO	4	
OENOTHERA VILLOSA	OEVI	1	O. STRIGOSA
OPUNTIA SPP. (PRICKLY PEARS)	OPUNTI	1	
OPUNTIA ENGELMANNII	OPEN	16	
OPUNTIA IMBRICATA	OPIM	3	
OPUNTIA POLYACANTHA	OPPO	24	
OREOCHRYSUM PARRYI	ORPA	252	HAPLOPAPPUS (SOLIDAGO) PARRYI
OREOXIS ALPINA	ORAL	3	
OREOXSIS BAKERI	ORBA	3	
OROBANCHE SP.	OROBAN	1	
OROBANCHE FASCICULATA	ORFA	1	
ORTHILIA SECUNDA	ORSE	224	PYROLA (RAMISCHIA) SECUNDA
ORTHOCARPUS LUTEUS	ORLU	1	
ORTHOCARPUS PURPUREO-ALBUS	ORPU	2	
OSMORHIZA CHILENSIS	OSCH	2	
OSMORHIZA DEPAUPERATA	OSDE	180	O. OBTUSA
OXALIS SPP.	OXALIS	7	
OXALIS VIOLACEAE	OXVI	5	
OXYBAPHUS LINEARIS	OXLI	14	MIRABILIS LINEARIS
OXYPOLIS FENDLERI	OXFE	28	
OXYTROPIS SPP.	OXYTRO	3	
OXYTROPIS LAMBERTII	OXLA	7	
OXYTROPIS SERICEA	OXSE	1	
PARNASSIA FIMBRIATA	PAFI	2	
PARTHENOCISSUS SPP.	PARTHE	3	
PEDICULARIS SPP	PEDICU	1	
PEDICULARIS BRACTEOSA	PEDBR	11	
PEDICULARIS CANADENSIS	PECAN	2	
PEDICULARIS GROENLANDICA	PEGRO	1	
PEDICULARIS GRAYII	PEGR	36	
PEDICULARIS PARRYI	PEPA	1	
PEDICULARIS RACEMOSA	PERA	95	
PENNELLIA MICRANTHA	PEMI	1	
PENSTEMON SPP.	PENSTE	2	
PENSTEMON BARBATUS	PEBA	107	
PENSTEMOM BRIDGESII	PEBR	7	
PENSTEMOM GRIFFINII	PEGRI	23	P. OLIGANTHUS
PENSTEMON LINARIOIDES	PELI	31	
PENSTEMOM VIRENS	PEVI2	8	
PENSTEMON VIRGATUS	PEVI	34	
PENSTEMON WHIPPLEANUS	PEWH	24	
PETASITES SAGITTATA	PESA	4	
PHACELIA SPP.	PHACEL	7	
PHACELIA HETEROPHYLLA	PHHE	15	
PHACELIA IVESIANA	PHIV	2	
PHACELIA NEOMEXICANA	PHNE	1	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
PHLOX SPP.	PHLOX	2	
PHLOX CONDENSATA	PHCON	3	P. CAESPITOSA
PHLOX NANA	PHNA	5	
PHYSALIS VIRGINIANA V. SONORAE	PHVI	2	P. LONGIFLORA
PHYSARIA ACUTIFOLIA	PHAC	1	P. AUSTRALIS
PIPERIA UNALASCENSIS	PIUN	1	HABENARIA UNALASCENSIS
PLANTAGO MAJOR	PIMA	1	
PNEUMONANTHE CALYCOSA	PNCA	4	GENTIANA PARRYI
POLEMONIUM SPP.	POLEMO	1	
POLEMONIUM FOLIOSISSIMUM	POFO	3	
POLEMONIUM PULCHERRIMUM	POPU	79	S. DELICATUM (P. DELICATUM)
POLEMONIUM VISCOSUM	POVI	1	
POLYGALA SPP.	POLYGA	1	
POLYGONUM SAWATCHENSIS	POSA	60	
POTENTILLA SPP.	POTENT	4	
POTENTILLA ANSERINA	POTAN	1	
POTENTILLA CONCINNA	POCON	2	
POTENTILLA CRINITA	POCR	8	
POTENTILLA DIVERSIFOLIA	PODI	7	
POTENTILLA GRACILIS V PULCHER	POGR	56	
POTENTILLA HIPPIANA	POHI	92	
POTENTILLA NORVEGICA	PONO	1	
POTENTILLA PENNSYLVANICA	POPE	6	
PRIMULA PARRYI	PRPA	7	
PRUNELLA VULGARIS	PRVU	7	
PSEUDOCYMOPTERIS MONTANUS	PSMO	248	
PSEUDOSTELLARIA JAMESIANA	PSJA	22	STELLARIA JAMESIANA
PSORALEA TENUIFLORA	PSTE	5	
PTERIDIUM AQUILINUM	PTAQ	10	
PTEROSPORA ANDROMEDA	PTAN	34	
PULSATILLA PATENS	PUPA	35	
PYROLA ASARIFOLIA	PYAS	29	
PYROLA CHLORANTHA	PYCH	70	P. VIRENS
PYROLA MINOR	PYMI	4	
PYROLA PICTA	PYPI	11	
RANUNCULUS SPP.	RANUNC	4	
RANUNCULUS ALISMAEFOLIUS	RAAL	2	
RANUNCULUS CARDIOPHYLLUS	RACA	1	
RANUNCULUS ESCHSCHOLTZII	RAES	7	
RANUNCULUS INAMOENUS	RAIN	2	
RANUNCULUS MACOUNNII	RAMA	2	
RANUNCULUS UNCINATUS	RAUN	2	
RATIBIDA COLUMNARIS	RACO	2	
RHODIOLA INTEGRIFOLIA	RHIN	14	SEDUM ROSEA
RUDBECKIA HIRTA	RUHI	6	
RUDBECKIA LACINIATA	RULA	14	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
RUMEX CRISPUS	RUCR	1	
SAXIFRAGA SPP.	SAXIFR	3	
SAXIFRAGA BRONCHIALIS	SABR	51	
SAXIFRAGA ODONTOLOMA	SAOD	9	
SAXIFRAGA RHOMBOIDEA	SARH	6	
SCUTELLARIA SPP	SCUTEL	1	
SEDUM SPP.	SEDUM	6	
SEDUM COCKERELLII	SECO	2	
SEDUM LANCEOLATUM	SELA	26	S. STENOPETALUM
SENECIO SPP.	SENECI	5	
SENECIO ATRATUS	SEAT	10	
SENECIO CROCATUS	SECR	1	
SENECIO DIMORPHOPHYLLUS	SEDI	1	
SENECIO EREMOPHILUS	SEER	22	
SENECIO FENDLERI	SEFE	110	
SENECIO HARTIANUS	SEHA	1	
SENECIO INTEGERRIMUS	SEIN	2	
SENECIO NEOMEXICANUS	SENE	90	
SENECIO NEOMEXICANUS V. MUT.	SENEMU	2	S. MUTABILIS
SENECIO SANGUISORBOIDES	SESA	13	
SENECIO SERRA	SESE	10	
SENECIO STREPTANTHIFOLIUS	SEST	28	S. CYMBALARIOIDES
SENECIO TRIANGULARIS	SETR	16	
SENECIO WOOTONI	SEWO	62	
SIBBALDIA PROCUMBERNS	SIPR	14	
SIDALCEA NEOMEXICANA	SINE	6	
SILENE SPP	SILENE	4	
SILENE ACAULIS	SIAC	2	
SILENE ANTIRRHINA	SIAN	1	
SILENE LACINIATA	SILA	1	
SILENE MENZIESII	SIME	20	
SILENE SCOULERI	SISC	39	
SISYMBRIUM SPP	SISYMB	1	
SMILACINA RACEMOSA	SMRA	125	
SMILACINA STELLATA	SMST	129	
SOLIDAGO SPP.	SOLIDA	56	
SOLIDAGO CANADENSIS	SOCA	3	
SOLIDAGO MISSOURIENSIS	SOMI	10	
SOLIDAGO MISS. VAR EXTRARIA	SOMIEX	1	
SOLIDAGO NANA	SONA	3	
SOLIDAGO SPARSIFLORA	SOSP	23	
SOLIDAGO SPATHULATA VAR NEOMEX	SOSPNE	39	SOLIDAGO DECUMBENS
SOLIDAGO SPATHULATA VAR NANA	SOSPNA	1	
SOLIDAGO WRIGHTII	SOWR	3	
SPHAERALCEA COCCINEA	SPHAER	1	
STACHYS COCCINEA	STCOC	2	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
STACHYS PALUSTRIS	STPA	3	
STELLARIA SPP.	STELLA	10	
STELLARIA LAETA	STLA	16	S. LONGIPES
STELLARIA UMBELLATA	STUM	10	
STEPHANOMERIA EXIGUA	STEX	1	
STREPTANTHUS SPP.	STREPT	1	
STREPTOPUS AMPLEXIFOLIUS	STAM	45	
SWERTIA PERENNIS	SWPE	2	
TARAXACUM SPP.	TARAXA	1	
TARAXACUM OFFICINALE	TAOF	96	
TETRADYMIA CANESCENS	TECA	1	
TEUCRIUM SPP.	TEUCRI	1	
THALICTRUM FENDLERI	THFE	180	
THELESPERMA FILIFOLIUM	THFI	2	
THELESPERMA MEGAPOTAMICUM	THME	5	
THELYPODIOPSIS LINEARIFOLIA	SILI	12	
THERMOPSIS SPP	THERMO	2	
THERMOPSIS SP.	THDI	47	T. (PINETORUM) DIVARICARPA
THERMOPSIS MONTANA	THMO	8	
THLASPI SPP.	THLASP	5	
THLASPI ARVENSE	THLAR	3	
THLASPI MONTANUM V. MONTANUM	THIMO	64	T. FENDLERI
TOWNSENDIA SPP.	TOWNSE	2	
TOWNSENDIA EXIMIA	TOEX	9	
TOWNSENDIA FORMOSA	TOFO	2	
TRADESCANTIA OCCIDENTALIS	TROC	1	
TRAGIA RAMOSA	TRRA	4	
TRAGOPOGON SPP.	TRAGOP	13	
TRAGOPOGON DUBIUS	TRDU	3	
TRAUTVETTERIA CAROLINENSIS	TRCA	12	T. GRANDIS
TRIFOLIUM SPP.	TRIFOL	14	
TRIFOLIUM BRANDEGEI	TRBR	4	
TRIFOLIUM DASYPHYLLUM	TRDA	9	
TRIFOLIUM DUBIUM	TRDU	1	
TRIFOLIUM PARRYI	TRPA	1	
TRIFOLIUM WORMSKJOLDII	TRWO	1	
TROLLIUS LAXIS	TRLA	11	
URTICA SPP.	URTICA	7	
URTICA DIOICA	URDI	3	
VALERIANA SPP	VALERI	3	
VALERIANA CAPITATA	VACA	16	SSP. ACUTILOBA
VALERIANA EDULIS	VAED	7	
VERATRUM CALIFORNICUM	VECA	16	
VERBASCUM THAPSUS	VETH	10	
VERONICA SPP.	VERONI	3	
VERONICA AMERICANA	VEAM	1	

Table A-1. (continued)

LIFE FORM/SPECIES/SIZE CLASS	CODE	OBS	SYNONOMY
VERONICA SERPHYLLIFOLIA	VESE	1	
VERONICA WORMSKJOLDII	VEWO	14	
VICIA AMERICANA	VIAM	136	
VICIA LUDOVICIANA V. TEXANA	VILU	2	V. EXIGUA
VICIA PULCHELLA	VIPU	1	
VIGUIERA SPP.	VIGUIE	2	
VIOLA SPP.	VIOLA	2	
VIOLA ADUNCA	VIAD	37	
VIOLA CANADENSIS	VICA	156	
VIOLA NEPHROPHYLLA	VINE	7	
WOODSIA SPP.	WOODSI	5	
WOODSIA OREGANA	WOOR	2	
WYETHIA AMPLEXICAULIS	WYAM	4	
WYETHIA ARIZONICA	WYAR	6	
ZYGADENUS SPP.	ZYGADE	38	

Table A-2. Successional status of trees within the northern New Mexico-southern Colorado habitat types. C=major climax, c=minor climax, S=major seral, and s=minor seral.

HT		PIEN	ABLA	PIFL	PIPU	ABCO	PSME	PIPO	POTR	PIAR	QUGA	PIED	JUSC	JUMO
Piar														
Feth		C								C				
Abla														
Popu														
Pien	p	C	c							s				
Abla	p	C	C						s					
Abla														
Oxfe		C	C						s					
Abla														
Vamy		C	C	s		s	s		S	s				
Abla														
Moss		C	C				s		s	s				
Abla														
Libo		C	C		s	S	S		S					
Abla														
Rupa		C	C			s	S		S					
Abla														
Erex														
Erex	p	C	C	s	s	S	S		S					
Rupa	p	C	C				S		S					
Pipu														
Libo		c	c	S	C	C	C		S					
Pipu														
Erex		c		S	C	C	C		S					
Pipu														
Cafo				s	C	c	C	S	S					
Pipu														
Aruv				S	C	C	C	S	S					
Pipu														
Fear				s	C	c	C	S	S					

Table A-2. (continued)

HT		PIEN	ABLA	PIFL	PIPU	ABCO	PSME	PIPO	POTR	PIAR	QUGA	PIED	JUSC	JUMO
Abco														
Vamy		c	c	s	c	C	C	s	S					
Abco														
Erex		c		s	c	C	C	s	S					
Abco														
Acgl		c		s	c	C	C	s	S		s			
Abco														
Sparse				s	c	C	C	s	S	s				
Abco														
Aruv				s		C	C	S	s					
Abco														
Fear				s		C	C	S	s					
Abco														
Quga				s		C	C	S	s		S			
Psme														
Aruv		c		C			C		S					
Psme														
Fear														
Piar	p						C		s	C				
Psme	p			s			C	S	s			s		
Psme														
Quga														
Fear	p						C	S			S	s	s	
Quga	p						C	S			S	s	s	
Pipo														
Aruv							c	C						
Pipo														
Fear														
Dapa	p							C						
Fear	p							C				c		
Bogr	p							C				C	c	c

Table A-2. (continued)

HT	PIEN	ABLA	PIFL	PIPU	ABCO	PSME	PIPO	POTR	PIAR	QUGA	PIED	JUSC	JUMO
Pipo Quga Fear	p						C			S		c	
Quga	p						C			S		c	
Pipo Mumo							C			s	c		c
Pipo-Pied Quga							C			S	C	c	c
Pipo Bogr Scsc	p						C				C	c	c
Bogr	p						C				C	c	c
Pipo Quun							C			S	C	c	c
Pipo Orhy							C						c

C.1

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